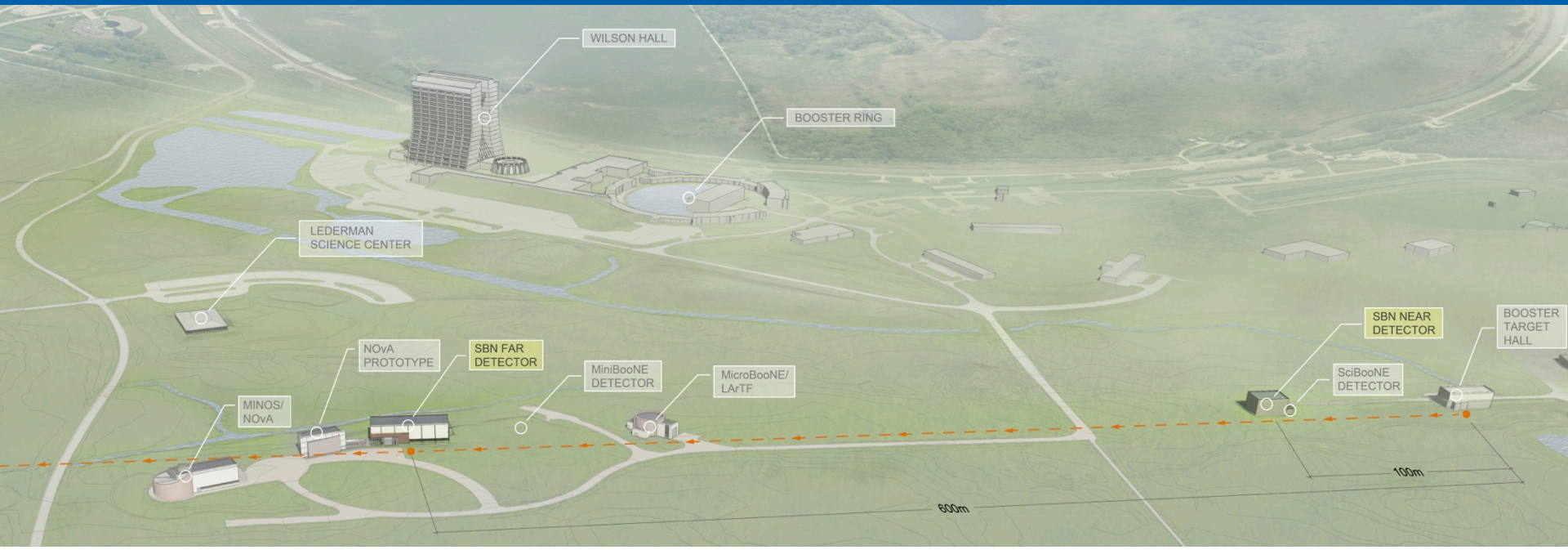


SBN Program Overview

Peter Wilson – SBN Program Coordinator

Director's Progress Review of the SBN Program

15 December 2015

Outline

- Physics motivation
- Program requirements
- Scope of the SBN program
- Resources: funding sources
- Cost summary (DOE)
- Program schedule
- Summary

Program not a Project

What the SBN Program IS:

- A physics program: search for sterile neutrinos
- A staged campaign to install and operate Three LArTPC detectors
- A component of detector R&D headed toward DUNE
- Mixture of in-kind contributions from several European and American organizations

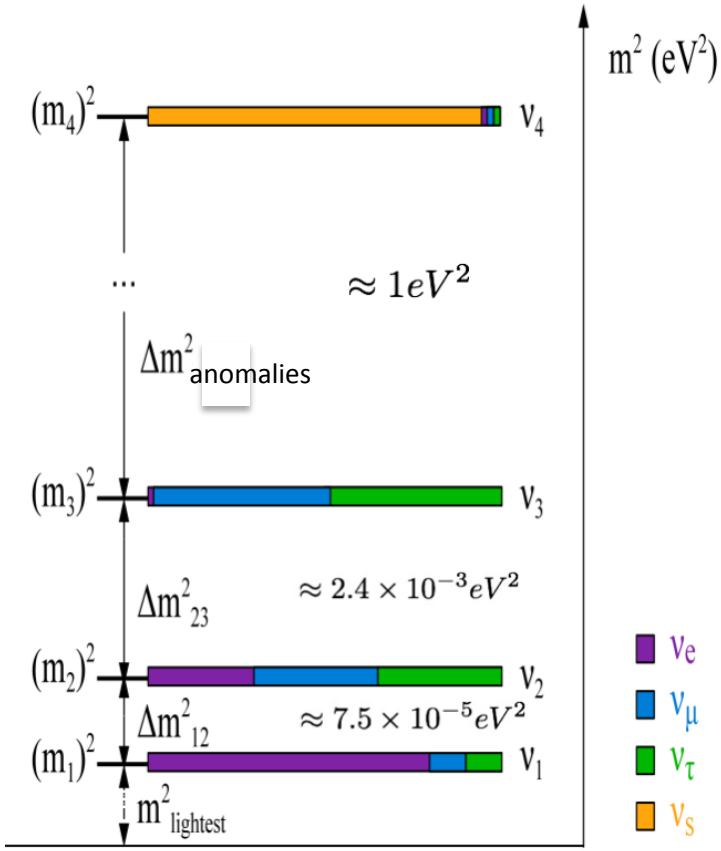
What the SBN Program IS NOT:

- A DOE 413 Project

SBN Physics Program

Physics Beyond the 3-ν SM?

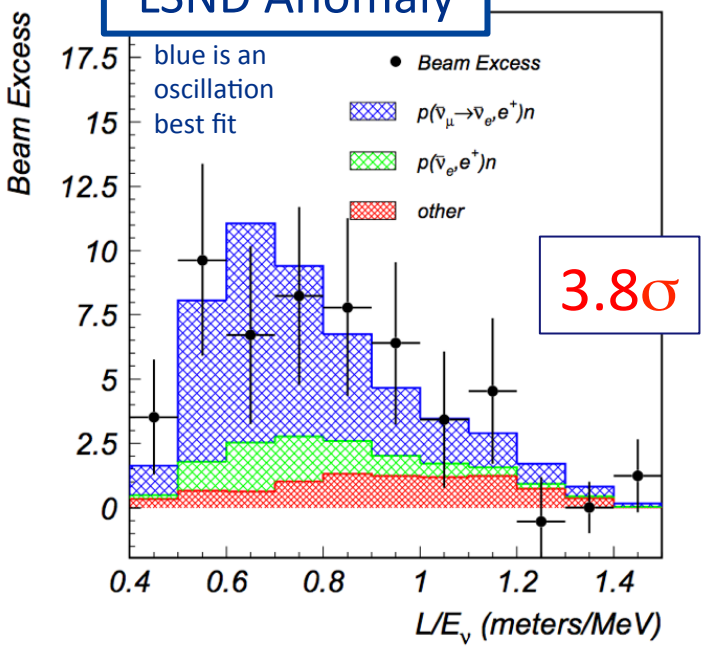
- In principle, oscillations can provide a window onto particle sectors not accessible through SM interactions
  - i.e. no strong, EM, or weak interactions
  - e.g. 'sterile' neutrinos
- Turns out anomalies are present in some existing data
  - While each of the measurements alone lack the significance to claim a discovery, together they could be hinting at important new physics
- The SBN program will contribute directly to this question either by making a significant discovery or by ruling out oscillations in a range hinted at by previous results



Very sensitive experiments are needed. Factor 10 smaller $\nu_\mu \rightarrow \nu_e$ oscillation probabilities than for θ_{13}!

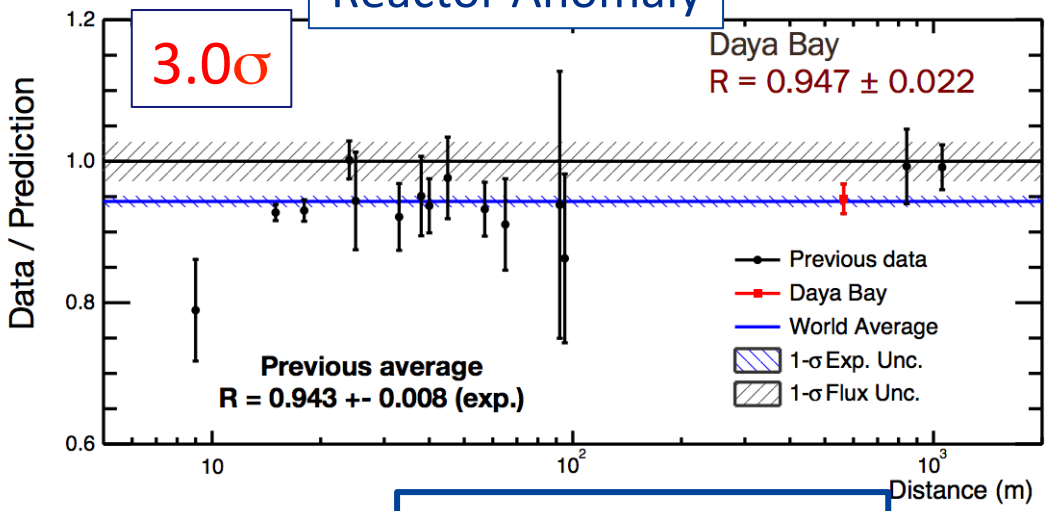
Some of the Existing SBL (high Δm^2) Anomalies

LSND Anomaly

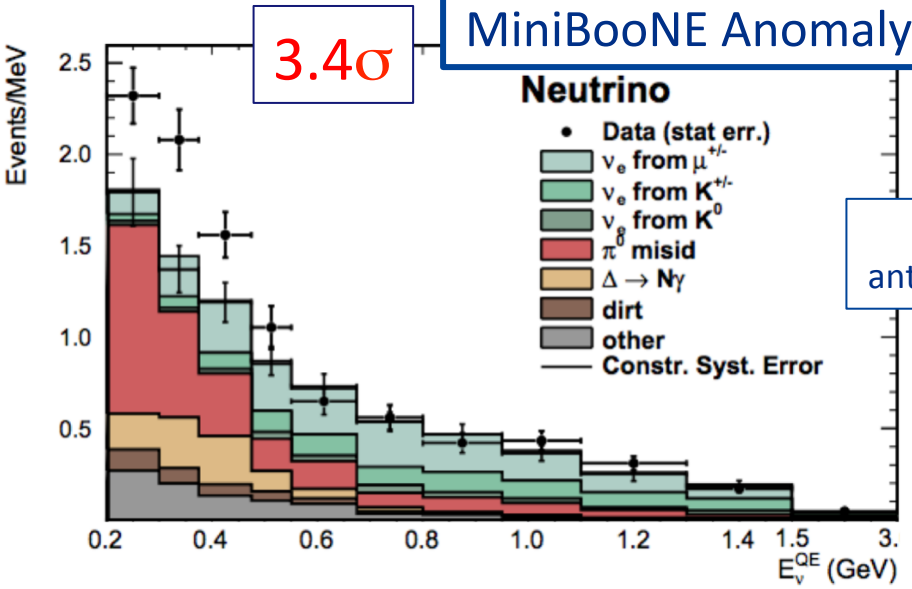


3.8σ

Reactor Anomaly



MiniBooNE Anomaly



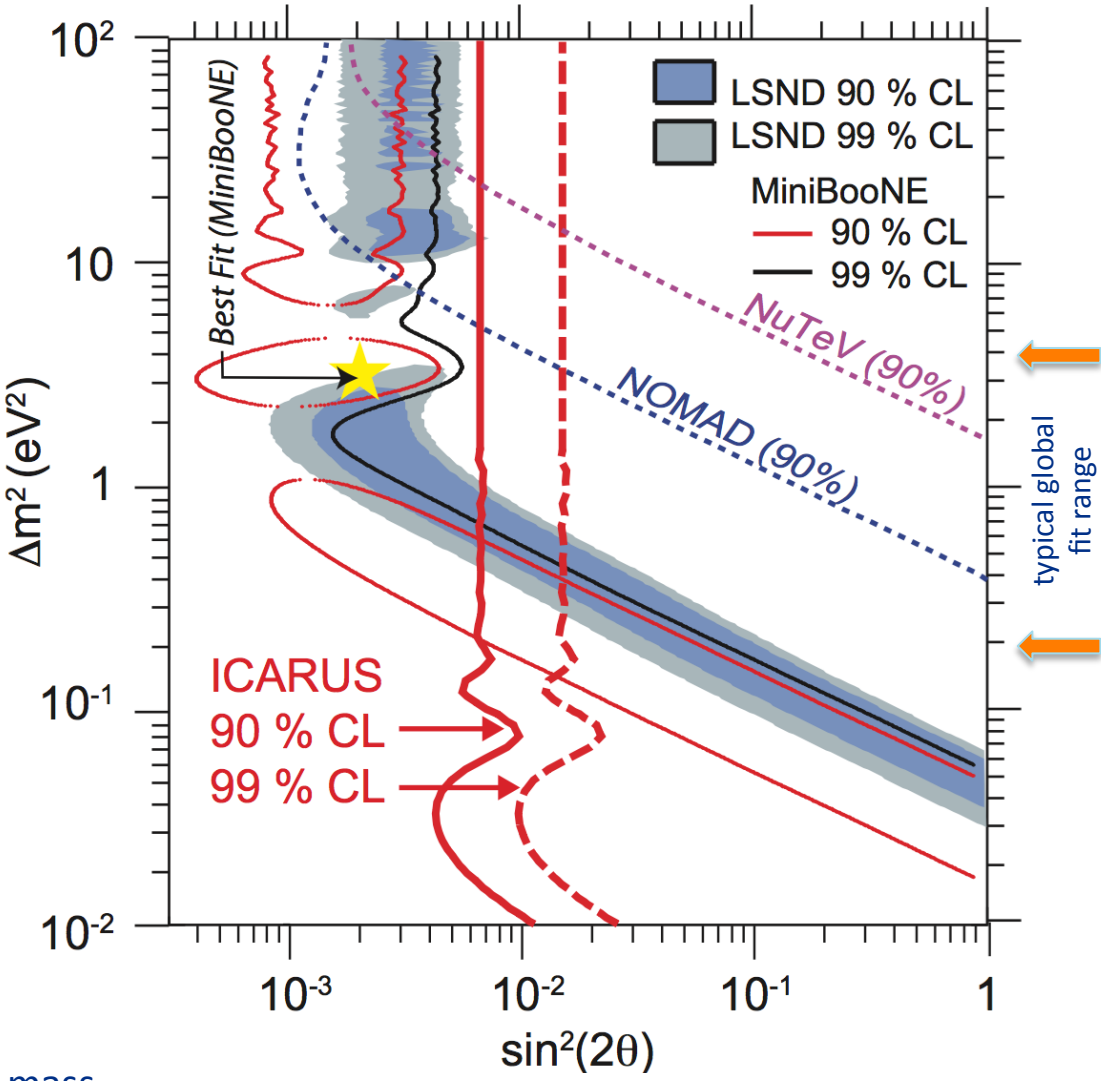
also in antineutrinos

Are these results evidence of new physics or caused by challenging SM backgrounds?

Possible Sterile Neutrino Parameters

- Positive signals in $\nu_\mu \rightarrow \nu_e$ (and antineutrino) and ν_e disappearance (and antineutrino)
- In particular, nothing seen yet in ν_μ disappearance
- Many global analyses that incorporate the positive and null results available
  - Kopp et al.
  - Conrad et al.
  - Giunti et al.
  - others

Recall the standard active neutrino mass splittings are down here (10^{-3} - 10^{-5} eV^2)



Brief History of Fermilab SBN Program

2003-13 - 1st gen. BNB experiments: MiniBooNE and SciBooNE

2015-18 - 2nd gen. BNB experiment: MicroBooNE - address the MiniBooNE low energy excess (e or γ) (SBN Phase I)

2009-13 - Proposals to address short-baseline anomalies using multiple LAr TPCs:

- X ICARUS@CERN: no ν beam at CERN
- X LAr1@FNAL: rejected by PAC and P5 – too expensive

Jan. 2014 – Two new proposals to Fermilab PAC for next phase at BNB:

- P-1052: ICARUS@FNAL: Updated ICARUS-T600 detector plus new T150 as near detector on the BNB for oscillation searches.
- P-1053: LAr1-ND*: LAr1-ND + MicroBooNE (possibly followed by 1kton scale far detector).

2014 – Proponents of ICARUS, LAr1-ND, and MicroBooNE, plus representatives from FNAL, INFN and CERN, work together to develop a coherent SBN physics program.

* Name change in April 2015: LAr1-ND ➔ Short-Baseline Near Detector (SBND)

P5 Recommendations

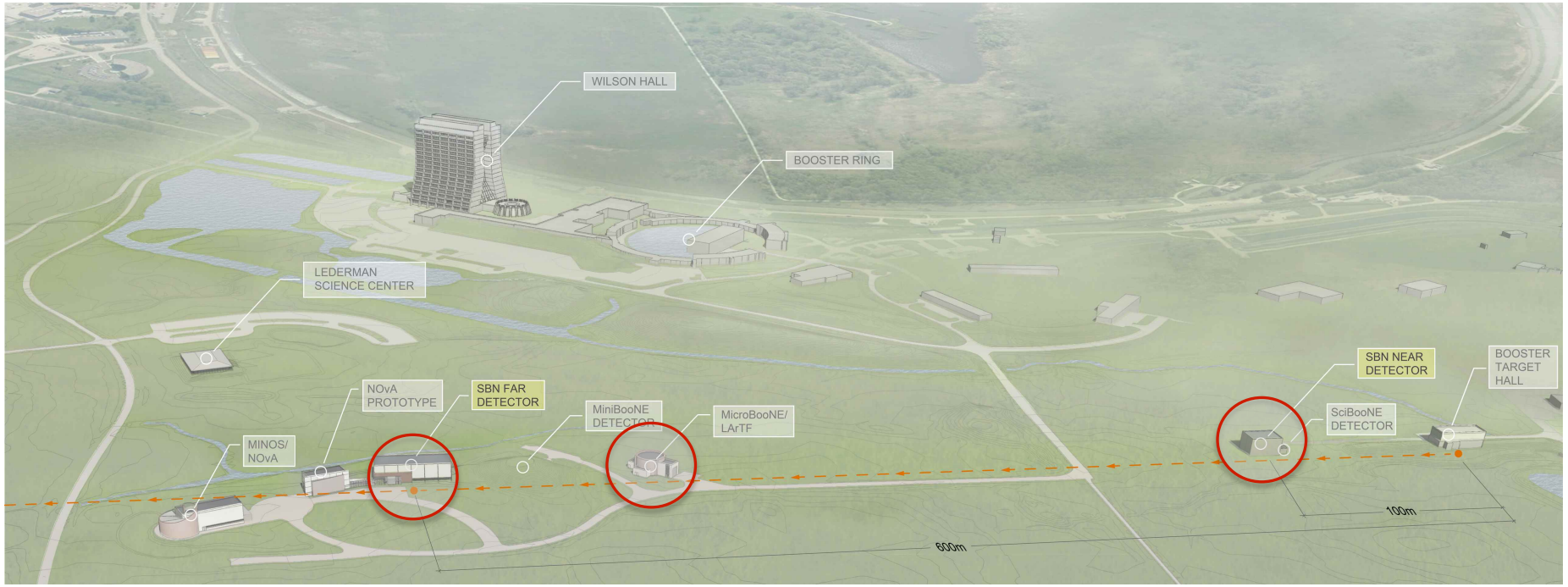
Building for Discovery
Strategic Plan for U.S. Particle Physics in the Global Context

Recommendation 12: In collaboration with international partners, develop a coherent short- and long-baseline neutrino program hosted at Fermilab.

May, 2014

Recommendation 15: Select and perform in the short term a set of small-scale short-baseline experiments that can conclusively address experimental hints of physics beyond the three-neutrino paradigm. Some of these experiments should use liquid argon to advance the technology and build the international community for LBNF at Fermilab.

SBN Program – Three detectors



ICARUS	MicroBooNE	SBND	Produce
Fewer ν_μ ?	Fewer ν_μ ?	ν_μ	ν_μ
More ν_e?	More ν_e?	~1% ν_e	~1% ν_e

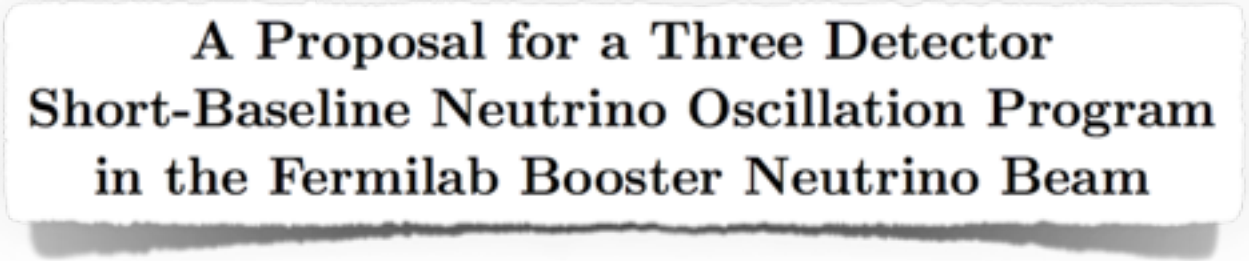
110m

470m

600m

The SBN Proposal

- Returned to the January 2015 PAC meeting with an updated proposal:



Submitted jointly by ICARUS, MicroBooNE and SBND (LAr1-ND)
http://arxiv.org/abs/1503.01520

Part I: SBN Physics Program

Part II: Near Detector Conceptual Design

Part III: T600 Design and Refurbishing

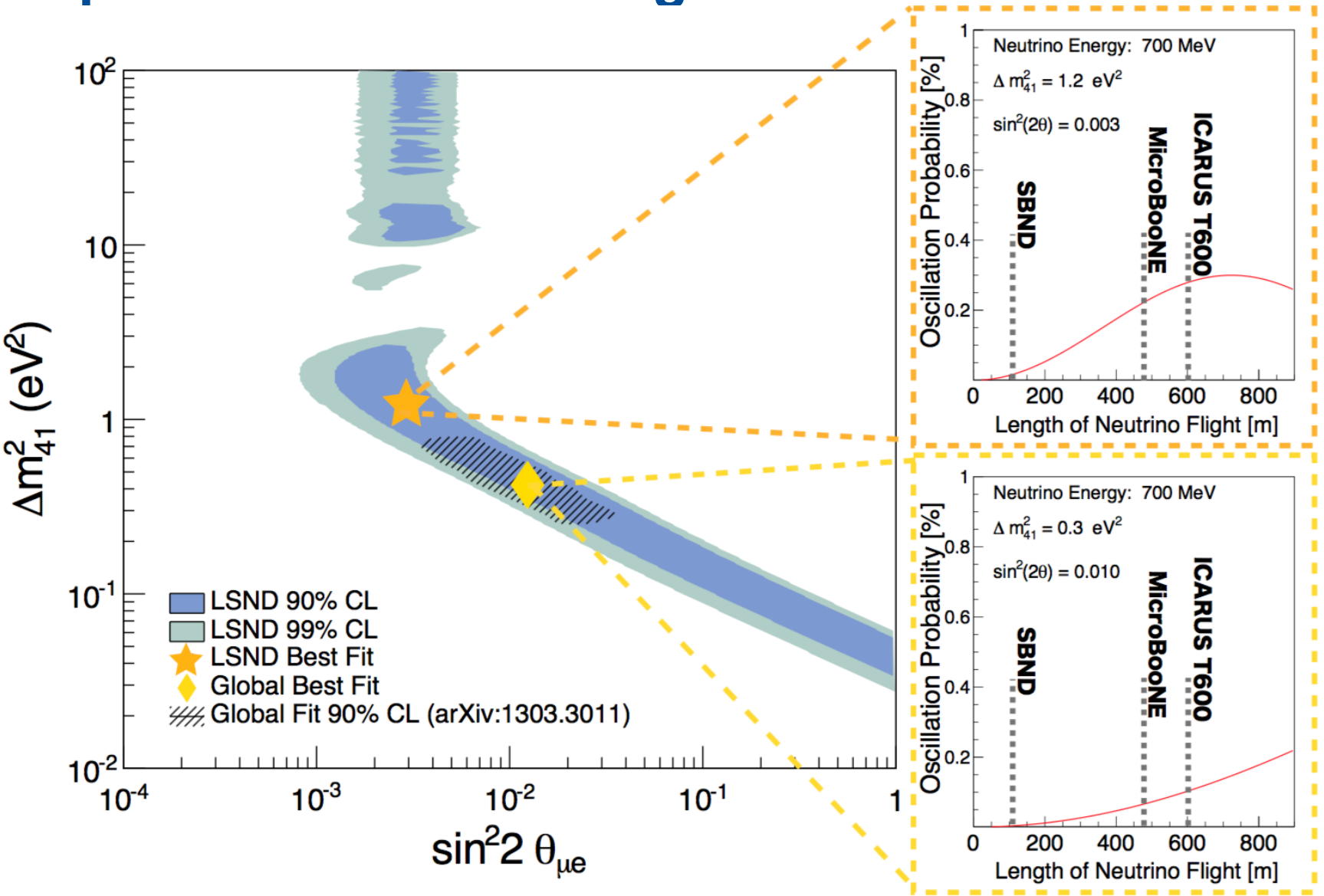
Part IV: Infrastructure and Civil Construction

Part V: Booster Neutrino Beam

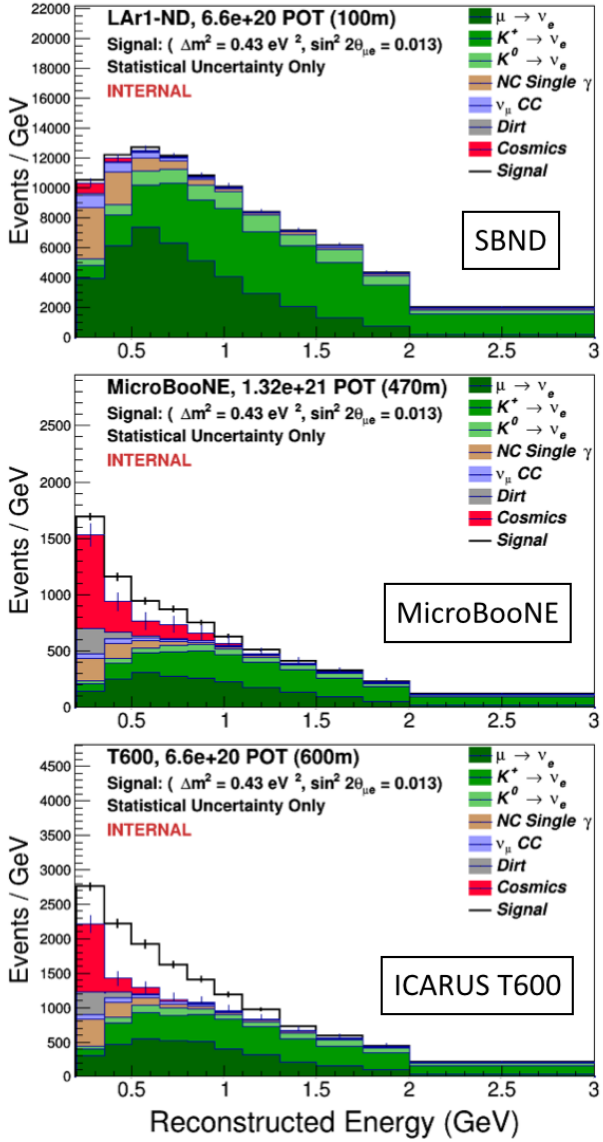
Part VI: Coordination and Schedule

Program Conceptual Design Report

Sample 3+1 Oscillation Signals in SBN



Backgrounds & Oscillation Signals in SBN

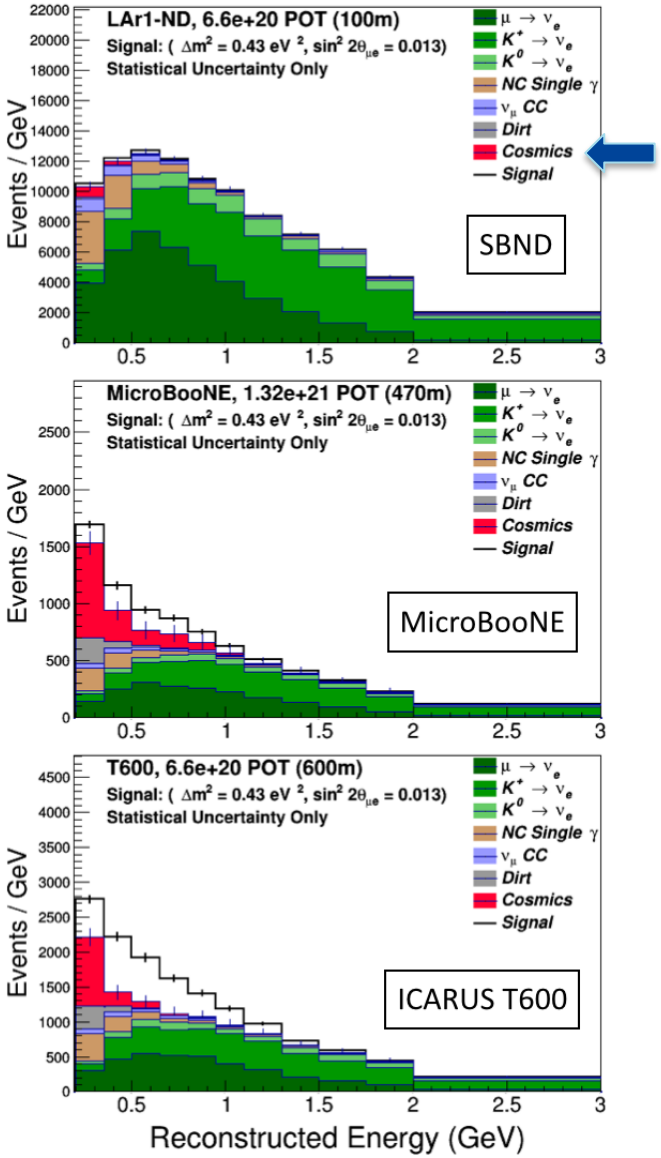


- Electron neutrino CC interactions
  - $\pi \rightarrow \mu \rightarrow \nu_e$
  - $K^+ \rightarrow \nu_e$
  - $K^0 \rightarrow \nu_e$

  → Intrinsic beam ν_e
  - Sample appearance signal

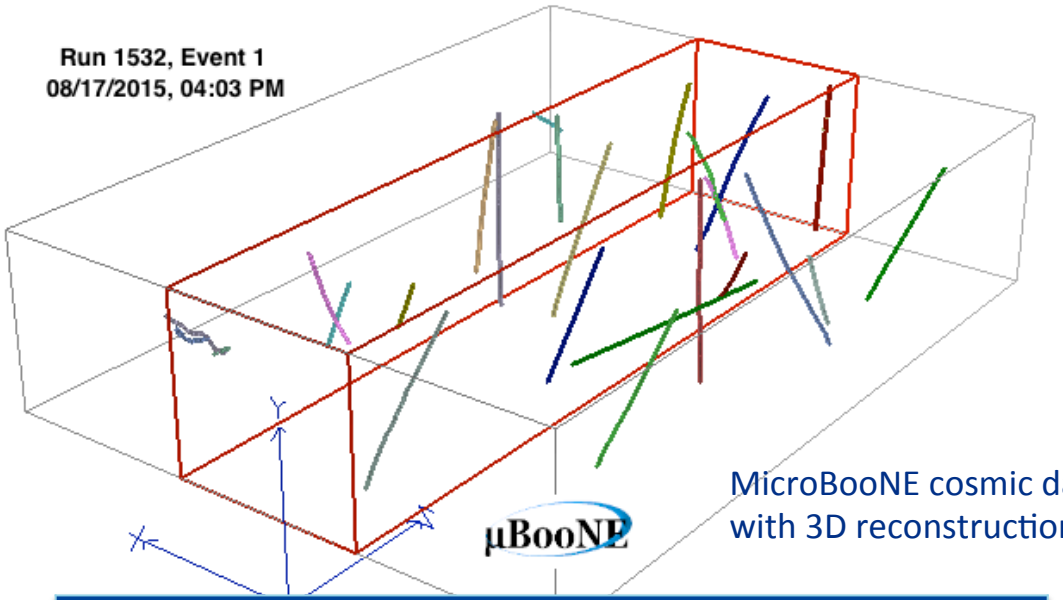
- Photon-induced e.m. shower backgrounds
  - NC misIDs
  - ν_μ CC misIDs
  - "Dirt" Backgrounds: beam-related but out-of-detector interactions
  - Cosmogenic photon sources

Cosmogenic Backgrounds



- The problem: 1000x longer charge drift time than the beam spill time!

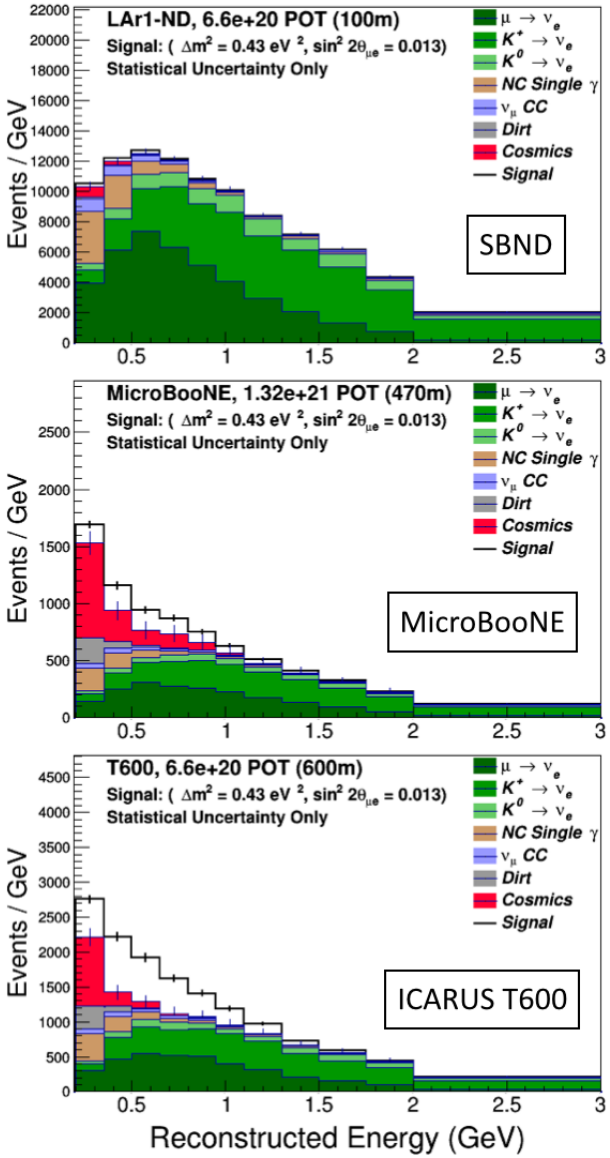
1.6 μs beam spill vs. 1-2 ms TPC drift time



MicroBooNE cosmic data with 3D reconstruction!

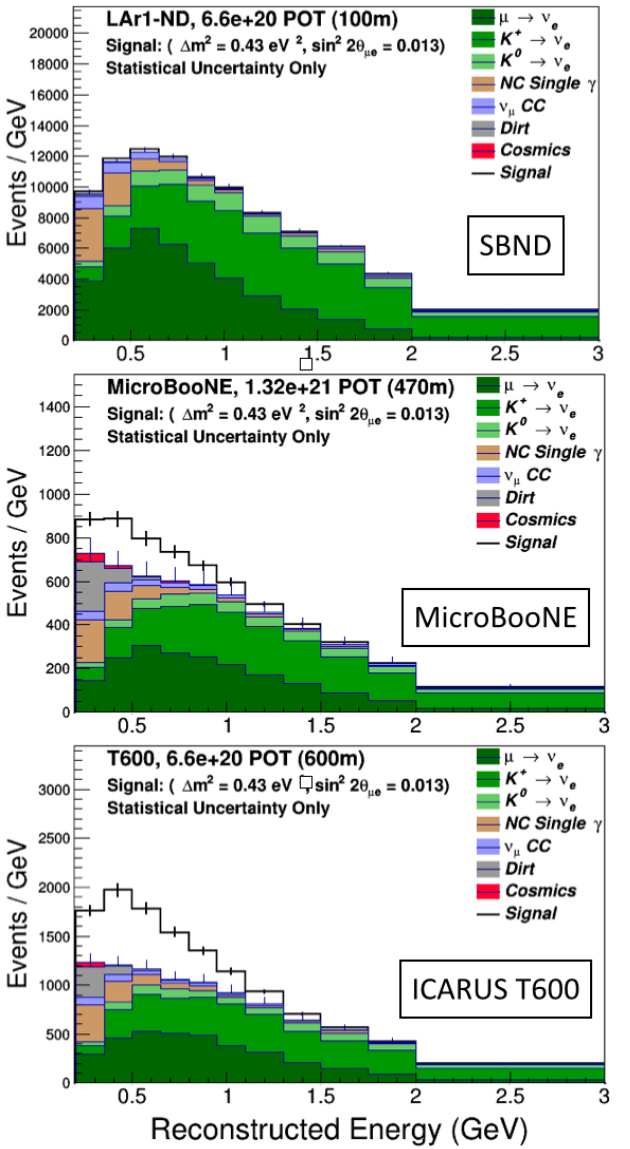
Detector	Neutrino interaction every N spills	Cosmic muon in beam spill time every N spills
SBND	20	250
MicroBooNE	600	200
ICARUS-T300	350	100

Cosmogenic Backgrounds

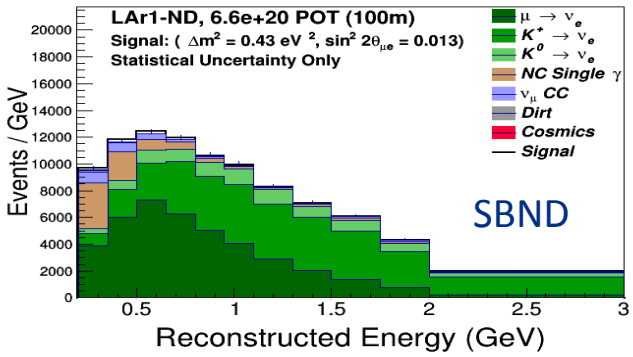


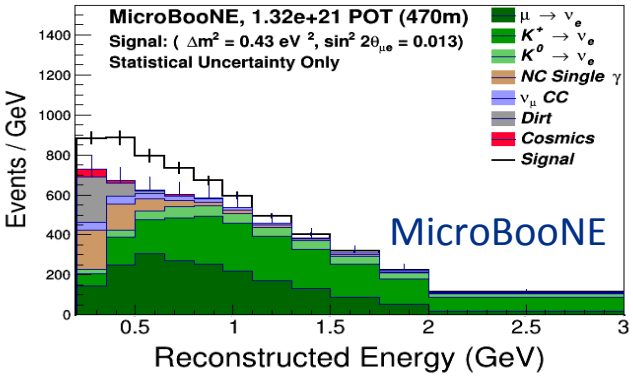
External cosmic ray tracker (CRT) systems can be employed to identify contaminated beam spills

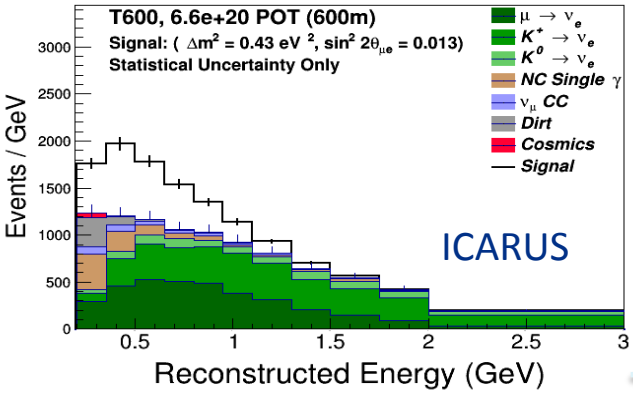
Off-beam triggers can be used to measure cosmic backgrounds to high precision – so negligible systematic uncertainties



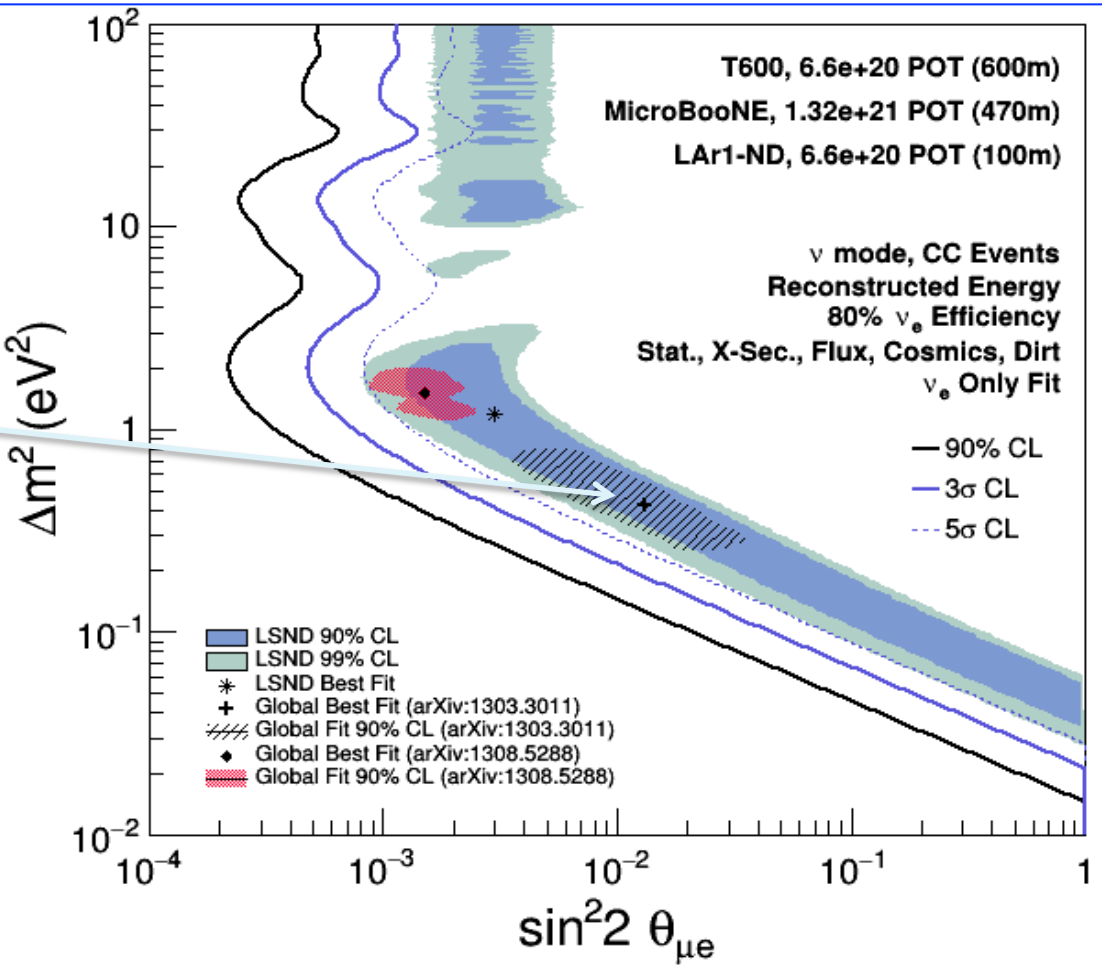
SBN ν_e Appearance Sensitivity







~5σ coverage of LSND 99% CL Region for 6.6x10^{20} P.O.T. ~ 3 years (13.2x10^{20} for MicroBooNE)



SBN Science Goals

- Directly follow up on the **MiniBooNE neutrino anomaly** by utilizing the LArTPC technology to determine the composition of the observed excess as electrons or photons (MicroBooNE during Phase I)

- Apply the advantages of the LArTPC technology and *multiple detectors at different baselines* to the question of high-Δm^2 **sterile neutrino oscillations** for the *first time*, testing current allowed oscillation parameters at $\geq 5\sigma$ (Phase II)

- Study ν-Argon interaction physics using **millions of events** from both the Booster and Main Injector neutrino beams at Fermilab

- Further **develop the LArTPC technology** toward the aim of applying it at very large scales for long-baseline physics in DUNE

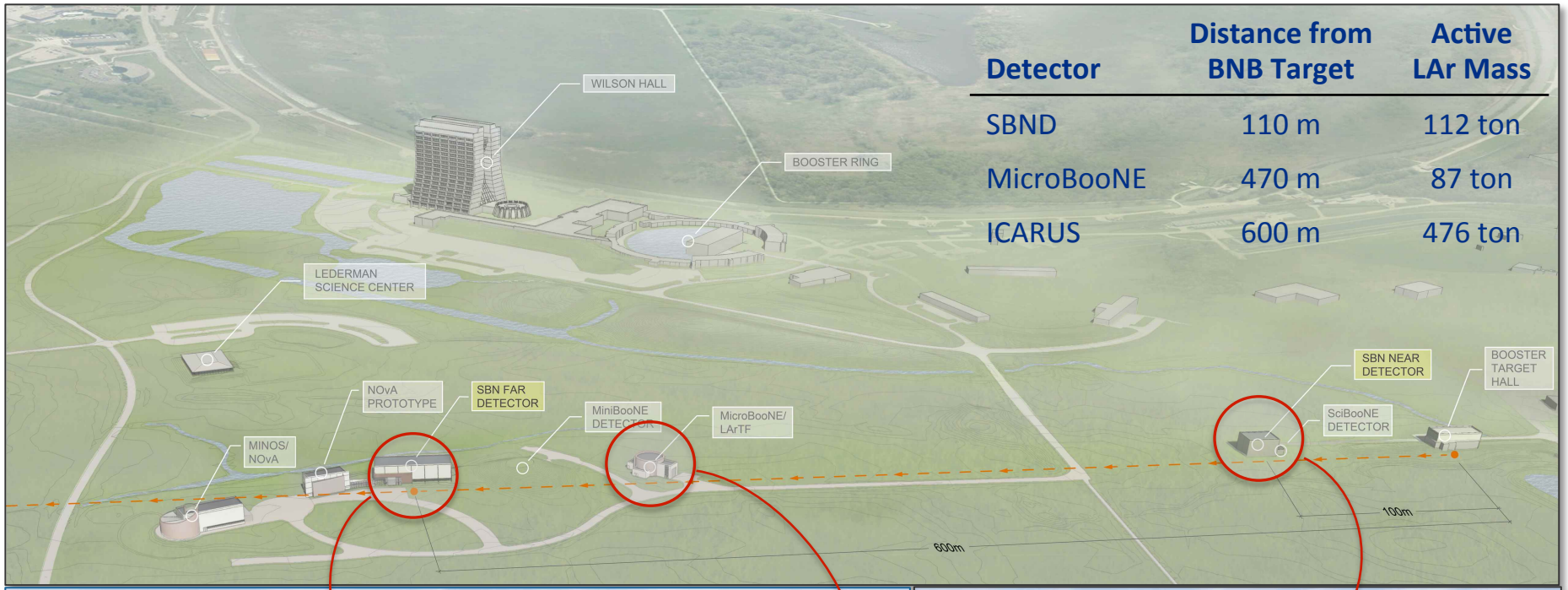
SBN Program Scope

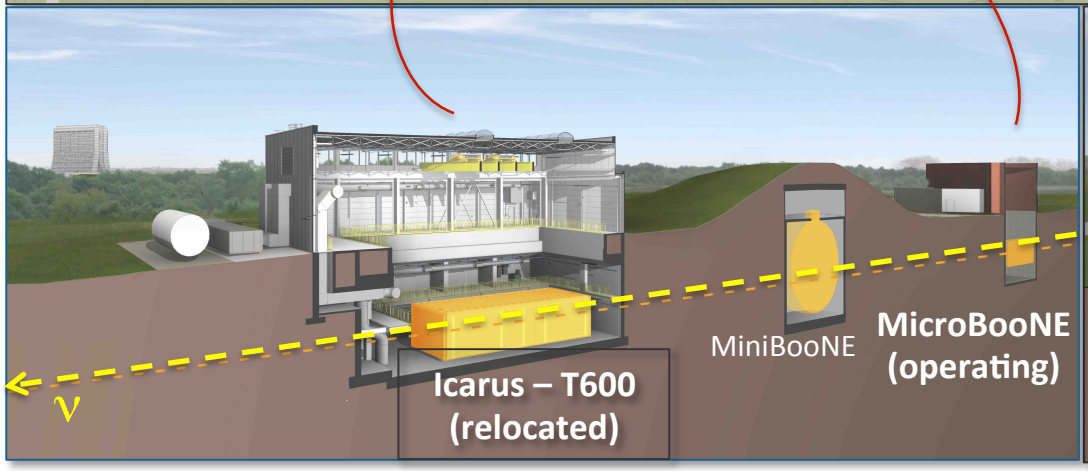
Program Requirements and Assumptions

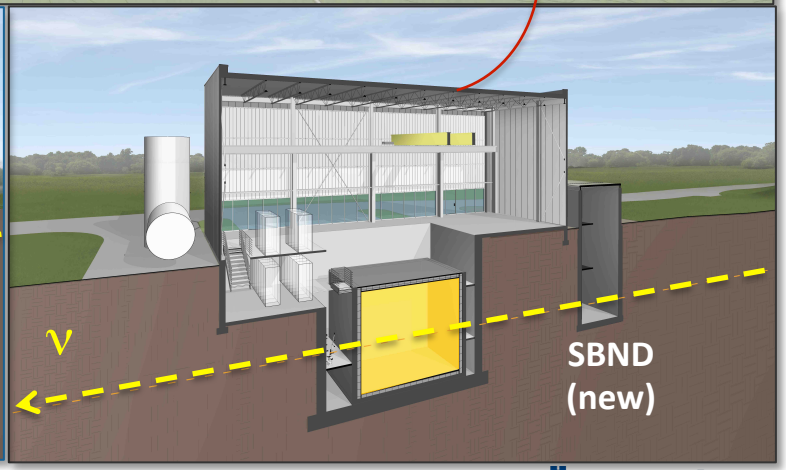
- Multiple LAr TPCs at different baselines
  - Flux systematics
  - Detector systematics
- Large far detector (~ 500t fiducial mass)
  - Statistics limited by far detector mass x neutrino flux x time
  - Program priority: earliest possible far detector operations
- Large integrated neutrino flux (> 13.2×10^{20} P.O.T. equivalent)
  - Statistics limited by far detector mass x neutrino flux x time
  - Implies 3+ years of beam
- Detector overburden and cosmics identification
  - Reject large cosmic background in TPC drift time

SBN Program – Three detectors

Detector	Distance from BNB Target	Active LAr Mass
SBND	110 m	112 ton
MicroBooNE	470 m	87 ton
ICARUS	600 m	476 ton



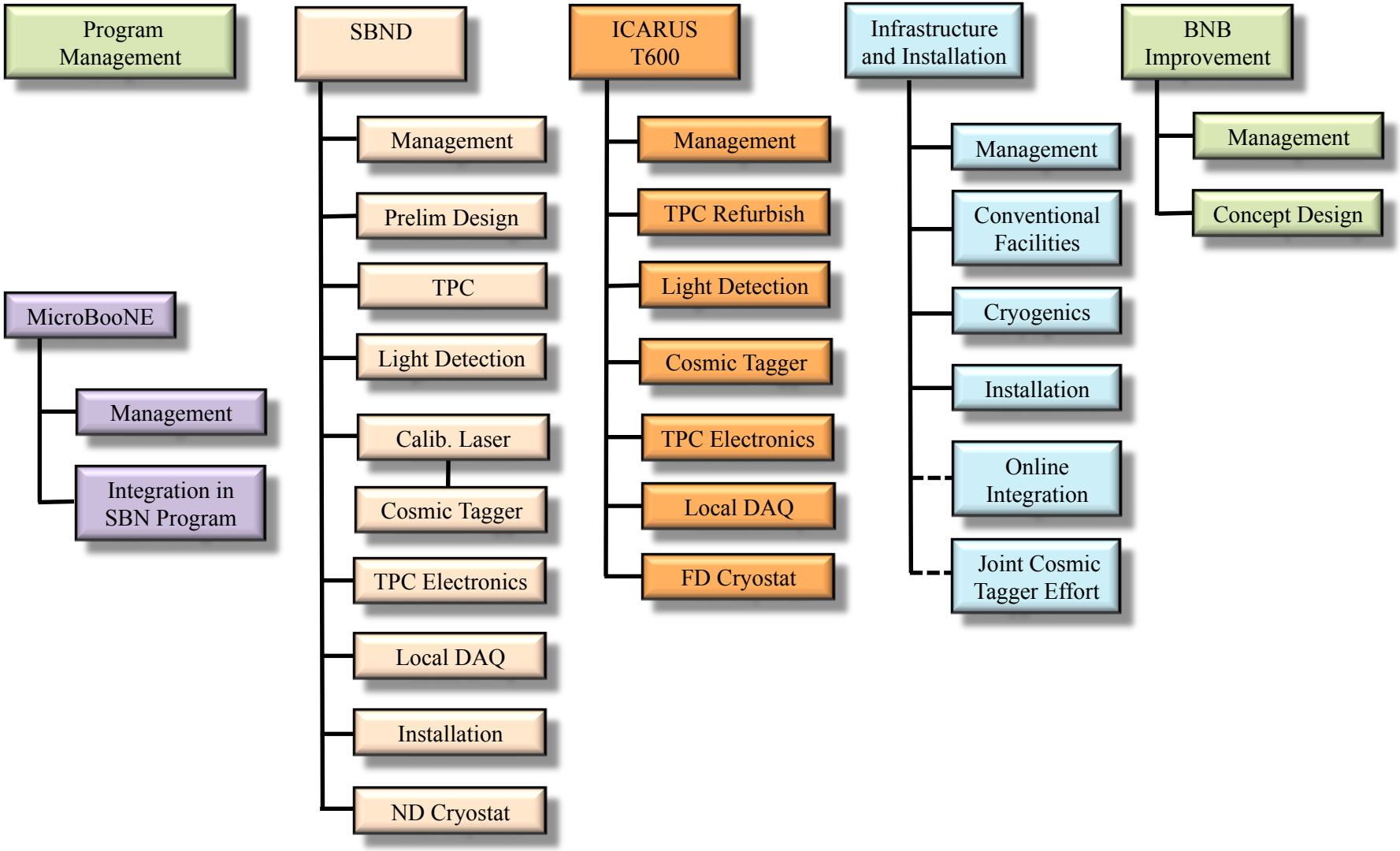




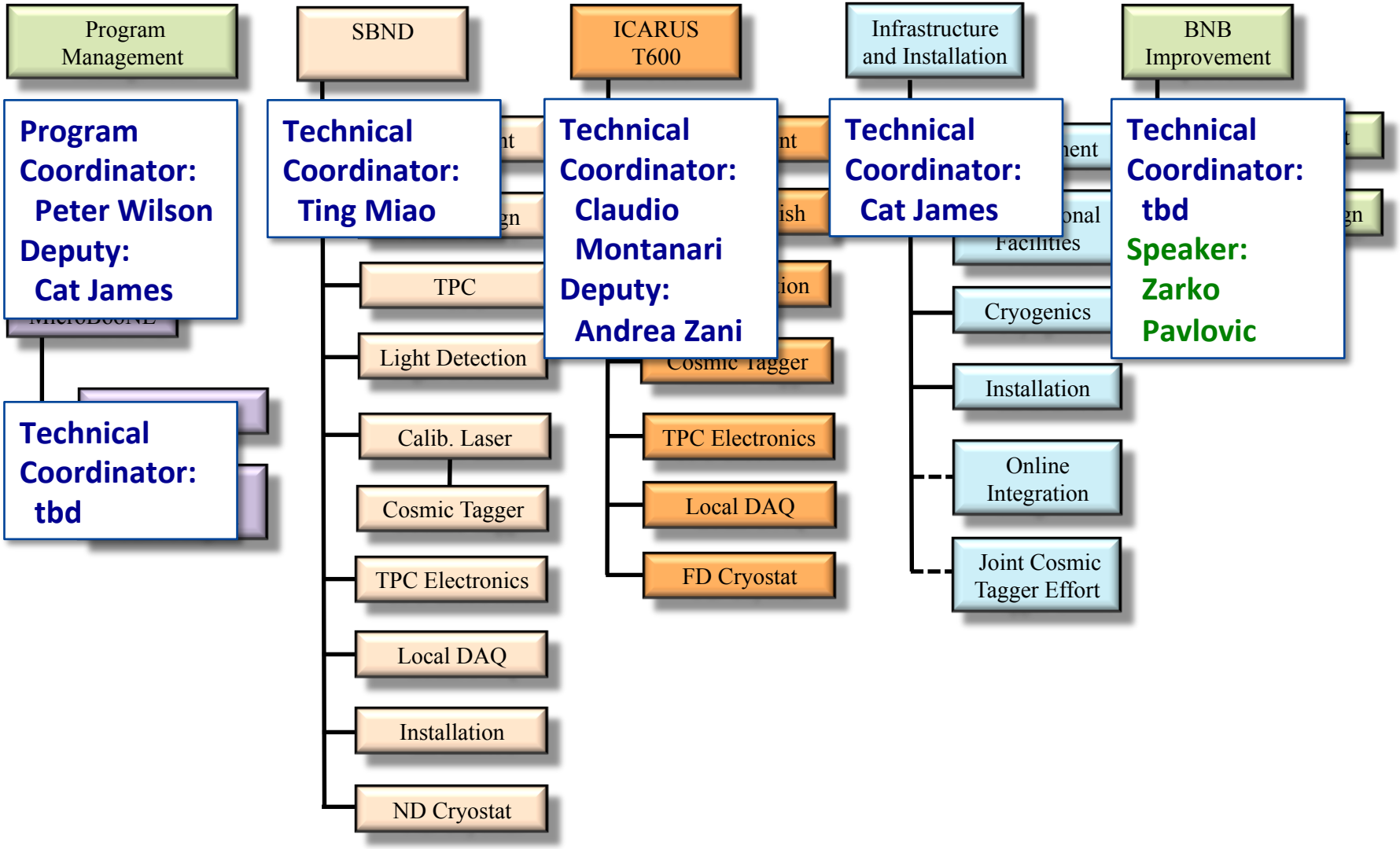
Scope of SBN Program Phases

Phase 1 (2015-18)	Included in this Review
Run 1 operations and physics of MicroBooNE	No
Design, construct, and install buildings and infrastructure	Yes
Refurbish, transport, and install ICARUS-T600	Yes
Design, construct, and install new ICARUS components	Yes
Design, construct, and install SBND	Yes
Upgrade Booster Neutrino Beam	*Yes*
Develop software and analysis tools	No
Phase 2 (2017-on)	
Fill and cold commission ICARUS	No
Fill and cold commission SBND	No
Operate three detectors	No
Physics analysis with three detectors	No

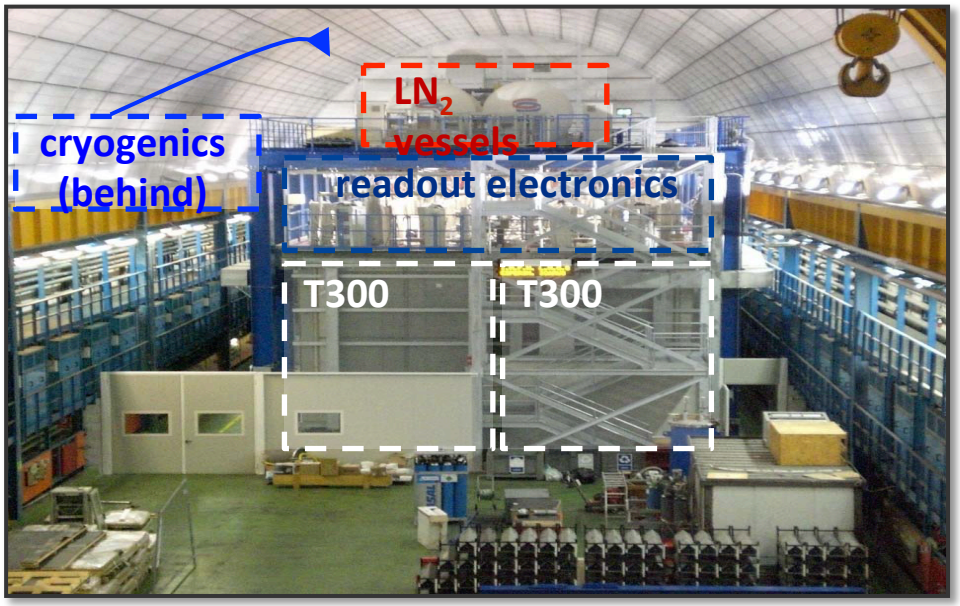
SBN Work Breakdown

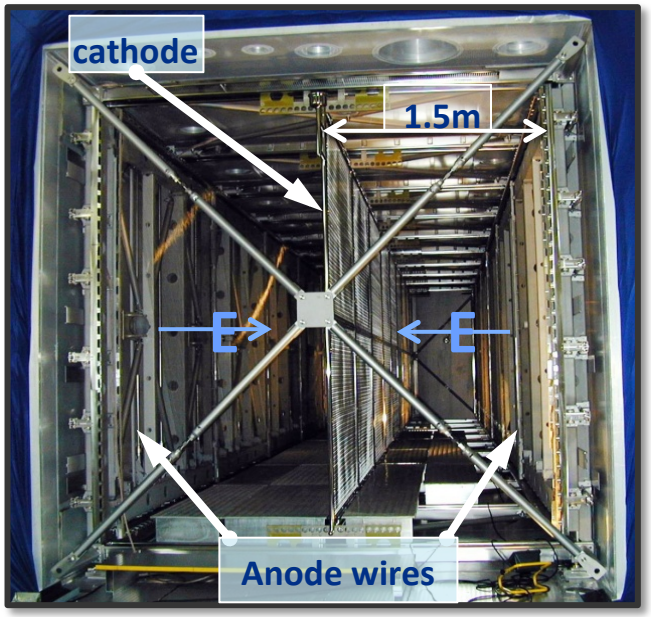


SBN Work Breakdown



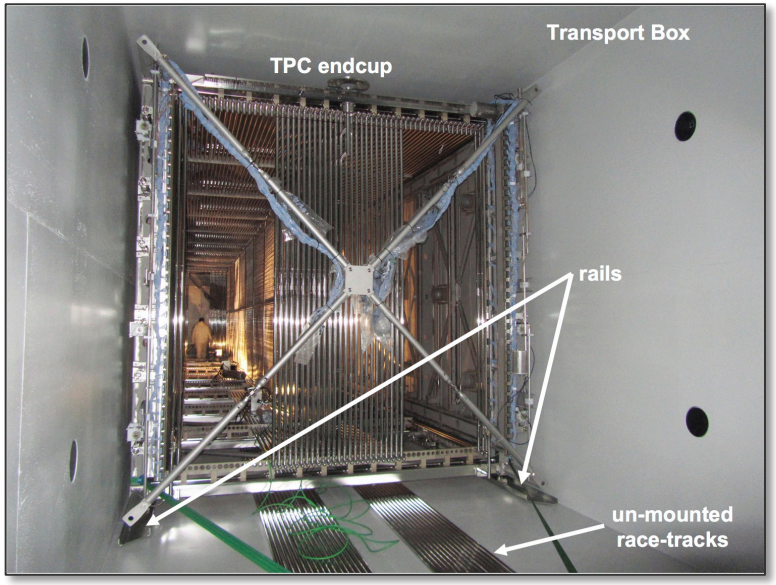
ICARUS-T600 at Gran Sasso





- Two identical modules (T300):
  - 3.6x3.9x19.6m^3 each
  - LAr active mass: ~476 t
  - Drift length = 1.5 m (1 ms)
  - Very high LAr purity achieved (τ_{ele} ~ 15ms)
- Two TPCs per module
  - 3 readout wire planes at 0, ±60°
  - ~ 54000 wires, 3 mm pitch and plane spacing
  - Charge measurement on collection plane
- PMTs for scint. light detection
  - 8” tubes (20 in one module, 54 on other)
  - VUV sensitive (128nm) with TPB wavelength shifter coating

ICARUS T600 Transport to CERN



Move to CERN completed
December 2014

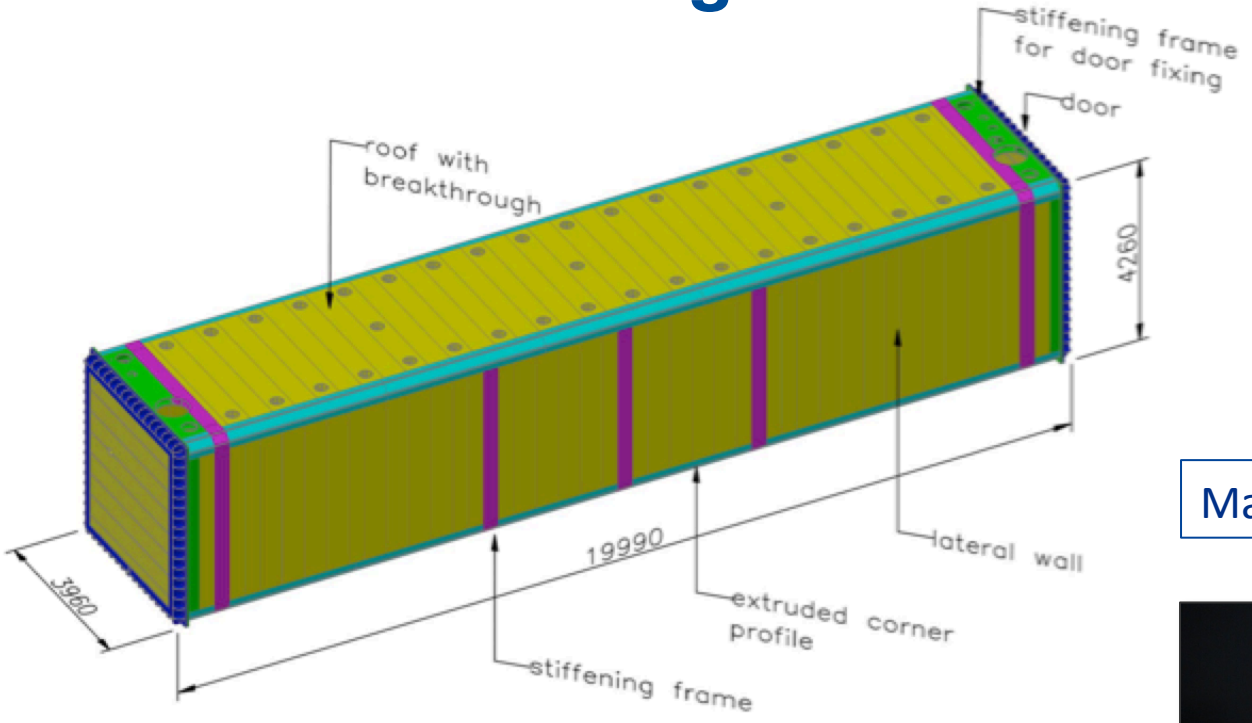
Scope of ICARUS Work at CERN (WA104)

- TPC refurbishing in progress:
  - New cryostats
  - Flatten cathodes
  - Replace internal TPC cabling
  - New HV decoupling boards
  - New 8” PMTs (90 per wire plane)
  - Upgrade TPC readout electronics
- Rebuild cryogenic system
- In planning stage (some may be DOE scope):
  - Cosmic Ray Tagger system
  - DAQ System

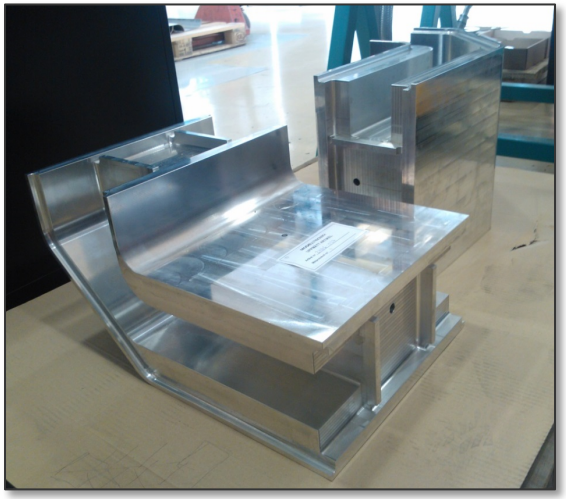
Details in talk by Claudio Montanari and Detector Breakout Session

First TPC Module in CERN Cleanroom

New Cold Vessel Design



Machined U-frame Corner



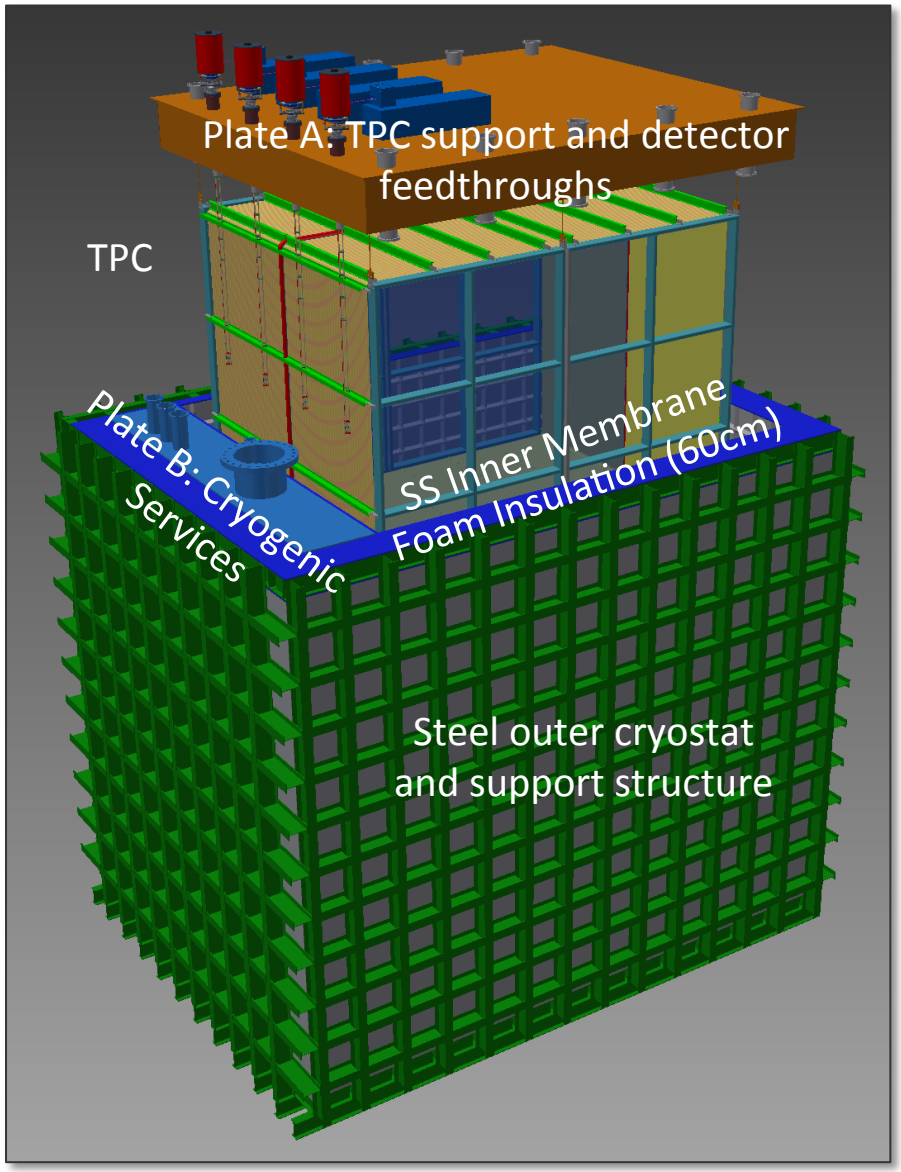
- Custom Al extrusions welded into panels at vendor
- U-frames assembled at CERN
- Final assembly at CERN

Details in talks by Claudio Montanari and Marzio Nessi (Infrastructure Breakout)

SBND Detector

- Completely new detector incorporating experience from ICARUS, MicroBooNE, LBNE 35 ton
- Coordinate with DUNE on designs
- Scope of work:
  - TPC design and construction
  - PMT (8”) system
  - Laser Calibration system
  - Cosmic Ray Tagger
  - Cold TPC readout electronics
  - DAQ (and electronics infra)
  - Membrane cryostat
  - Integration and Installation

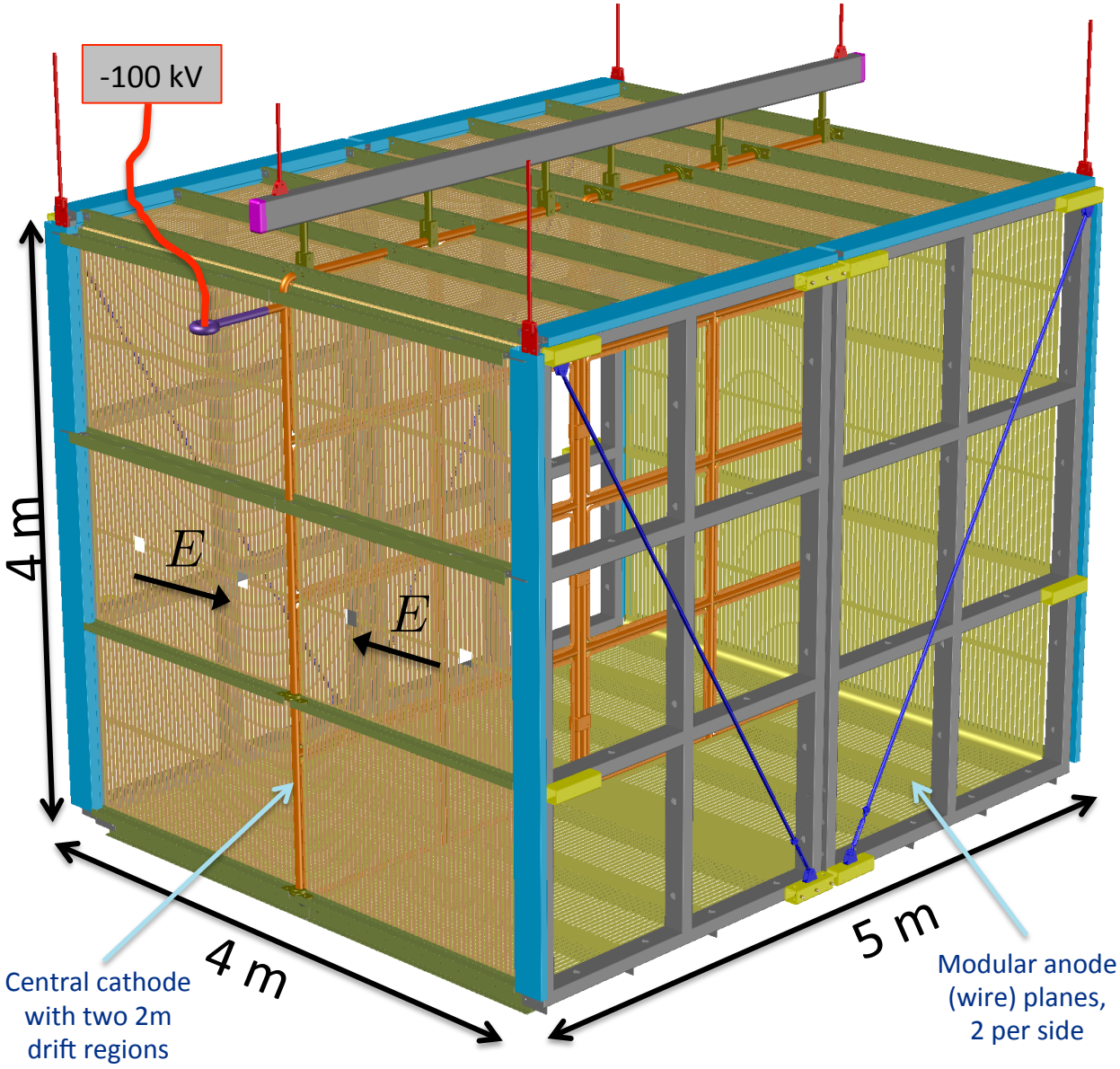
Details in talks by Ting Miao and Detector breakout sessions



SBND TPC

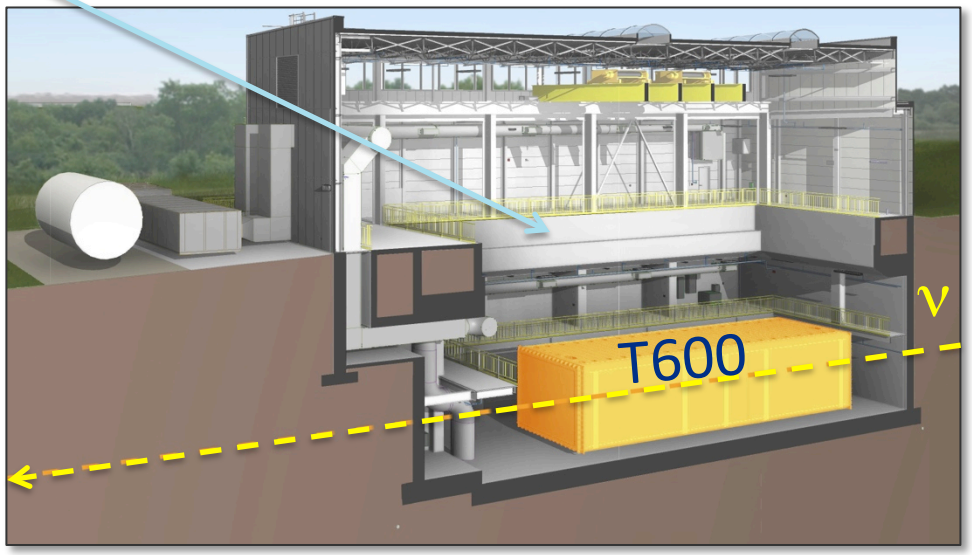
- Joint design and construction project of UK-US univs
- Fabricate components in 2017
- Assemble and install at FNAL in 2017

Details in talks by Ting Miao and Kostas Mavrokoridis



Far Detector Building

- Close cooperation between ICARUS, CERN and Fermilab on design requirements and review.
- Designed for 3m concrete overburden over detector to mitigate cosmogenic backgrounds for near surface operation
- Milestones:
  - ✓ Aug 2015 – Start preliminary design
  - ✓ March 2015 - Design complete
  - ✓ April 2015 - Construction contract bidding
  - ✓ July 2015 – Construction Start
  - ✓ Sept 2015 – Excavation complete
  - – Jan 2016 – Concrete complete
  - – June 2016 – Building envelope complete
  - – Oct 2016 - Substantial completion

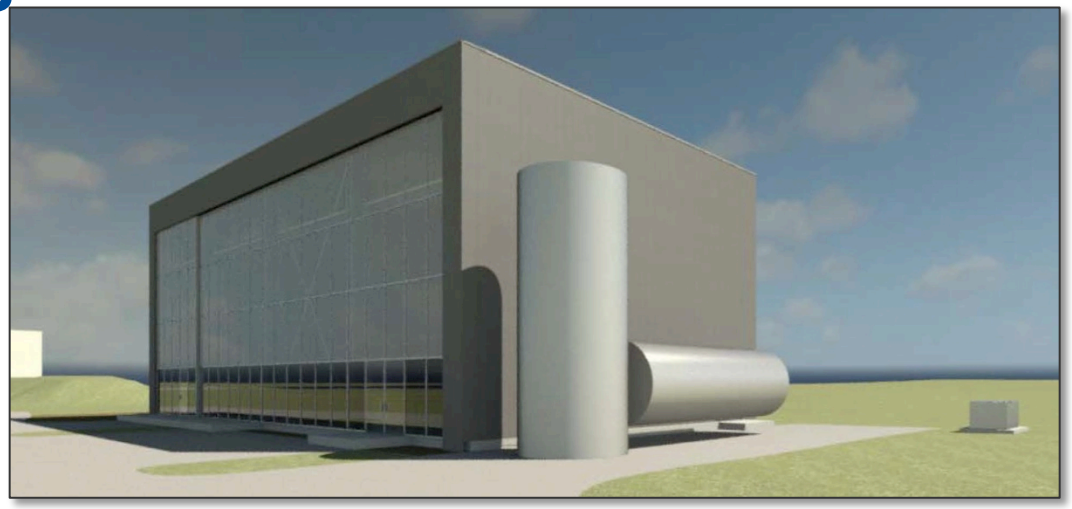


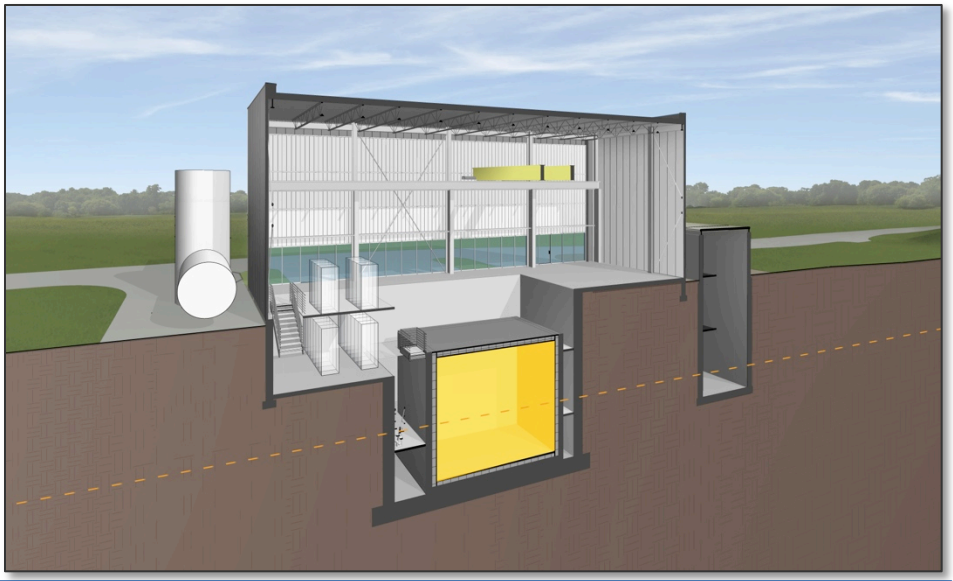
Details in talks by Cat James and Steve Dixon

Far Detector Building Progress

Near Detector Building

- Designed for 3m concrete overburden inside building to mitigate cosmogenic backgrounds for near surface operation
- Milestones:
  - ✓ Jan 2015 – Design start
  - ✓ May 2015 - 60% Design complete
  - ✓ July 2015 – Final design review
  - ✓ Aug 2015 - Design complete
  - ✓ Oct 2015 - Bidding complete
  - – Dec 2015 – Notice to proceed
  - – Mar 2016 – Construction start
  - – Nov 2016 - Substantial completion





Details in talks by Cat James and Steve Dixon

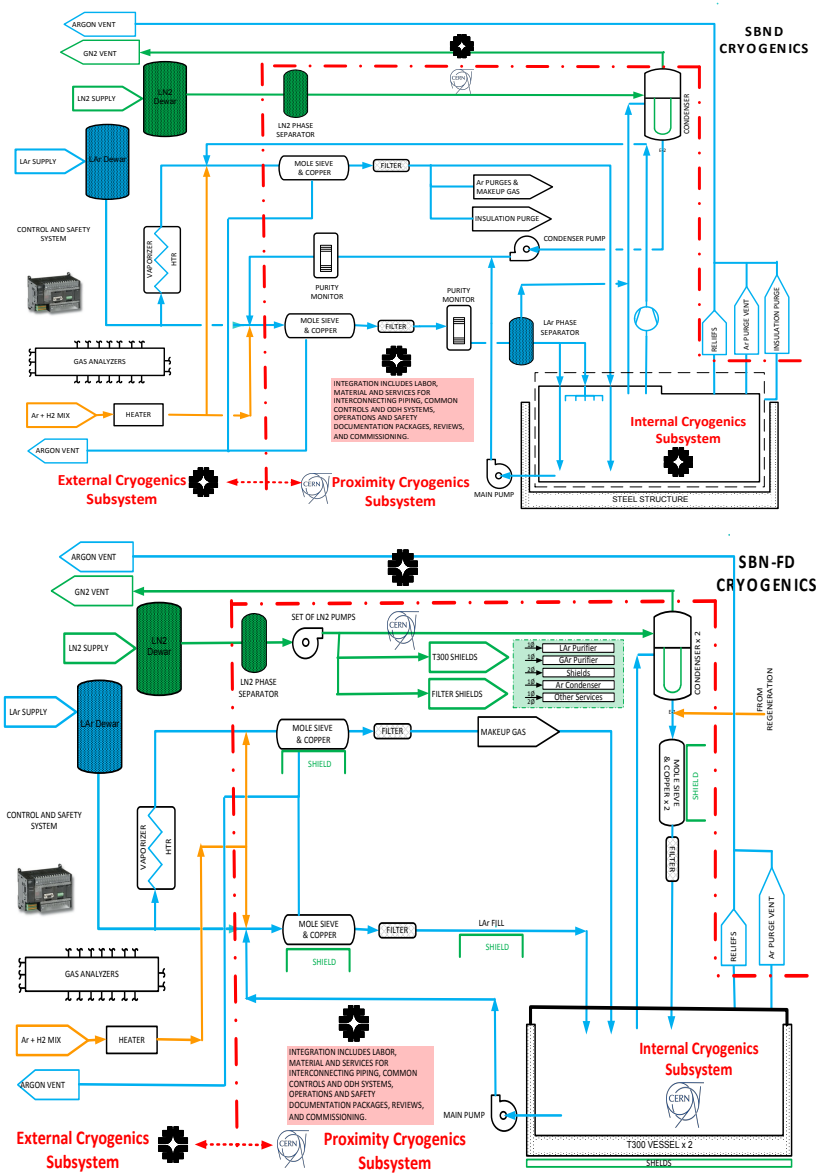
Detector Overburden

- Cosmic backgrounds in proposal assumed 3m of concrete overburden over both near and far detectors
  - Buildings designed to accommodate but not included in GPPs
- Scope for both detectors:
  - 40” thick (1.01m) of new bridging concrete blocks
  - 72” (1.78m) thick of recovered concrete shield blocks
  - Includes installation of blocks
  - Included in plan for DOE deliverables in FY18

Details in talks by
Cat James and Jim Kilmer

Scope of Cryogenics Systems

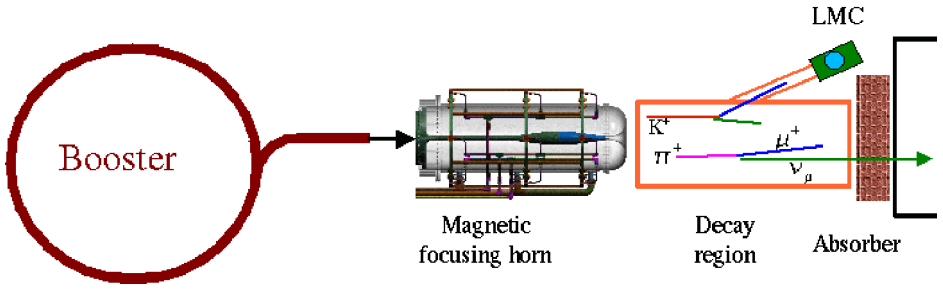
- Rebuild ICARUS cryogenic system
- New SBND cryogenic system
- Joint CERN-Fermilab responsibility
- Worked partitioning:
  - Internal : inside the cryostat
    - ICARUS – CERN scope
    - SBND – Fermilab scope
  - Proximity : Argon circulation & filtering
    - SBND & ICARUS - CERN scope
  - External : Nitrogen & Argon delivery
    - SBND & ICARUS - Fermilab scope
  - Controls – Femilab scope



Details in talks by Cat James, Michael Geynisman and Barry Norris

Booster Neutrino Beamline Improvements

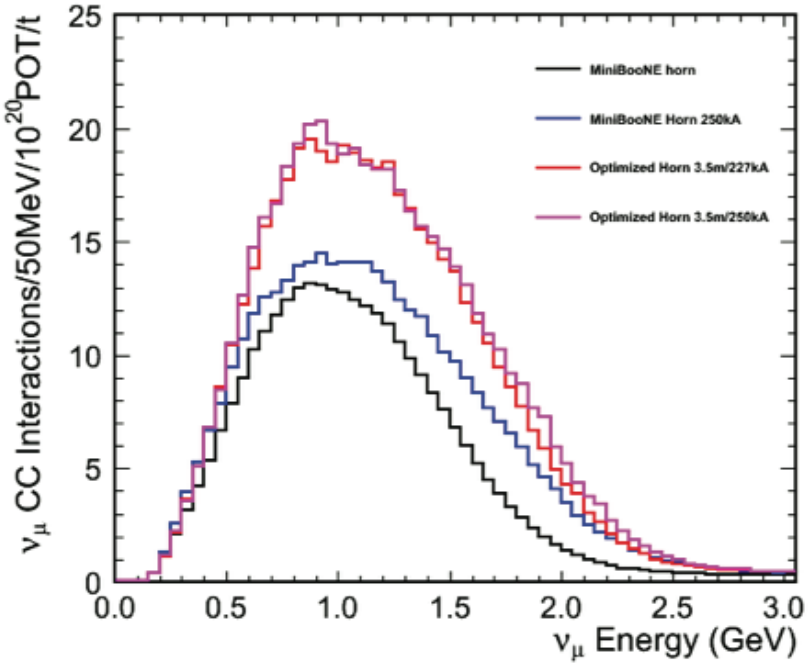
- The sterile ν search is limited by far detector statistics
  - Detector mass x Neutrino flux x Time
  - Far detector is expensive (>$10M for building alone)
- Increased ν flux would further secure the program sensitivity
  - Higher ν production efficiency
  - More protons on target (P.O.T.)



- Current BNB ν energy distribution optimized for MiniBooNE
  - LAr-TPCs more tolerant of high energy tail (distinguish NC π^0 background)
  - Allows for reconsideration of target and horn design
- P.O.T. was limited to 5 Hz average
  - After PIP, Booster up to 15 Hz when NUMI beam (and Muon program) is off
  - Upgraded power supply would permit more opportunistic use of beam pulses

Booster Neutrino Beamline Improvements

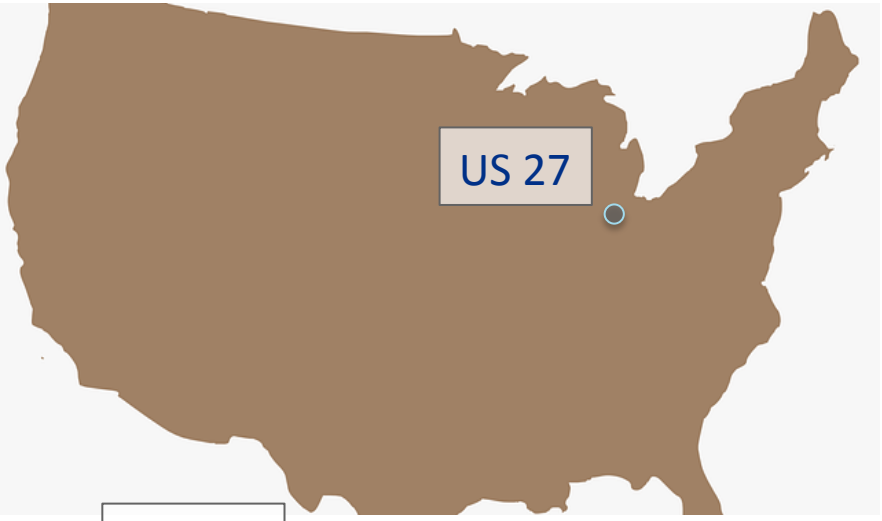
- PreConceptual design work considered three options:
  1. Two horn system plus new PS (too expensive)
  2. Short, improved MiniBooNE-style horn + PS mods
  3. New horn, max. length (3.5m) + PS mods
- Focus on option 3:
  - Add 60-70% more neutrinos
  - Estimate cost about $6M
- Request Accelerator Improvement Project (AIP) funds starting in FY17



Details in talk by Zarko Pavlovic

Planning and Resources

SBN Institutions and Authors



Collaboration	Authors	Overlap
ICARUS	~70	~6+8
SBND	112	~59
MicroBooNE	140	
All SBN (excl overlaps)	**~225**	

Institutions	SBN	SBN-DUNE Overlap
US	27	25
Non-US	28	24

Primary SBN Funding Sources

U.S. DEPARTMENT OF ENERGY | Office of Science

NSF

INFN

CERN

Science & Technology Facilities Council

FNSNF
Swiss National Science Foundation

ICARUS Funding Source Matrix

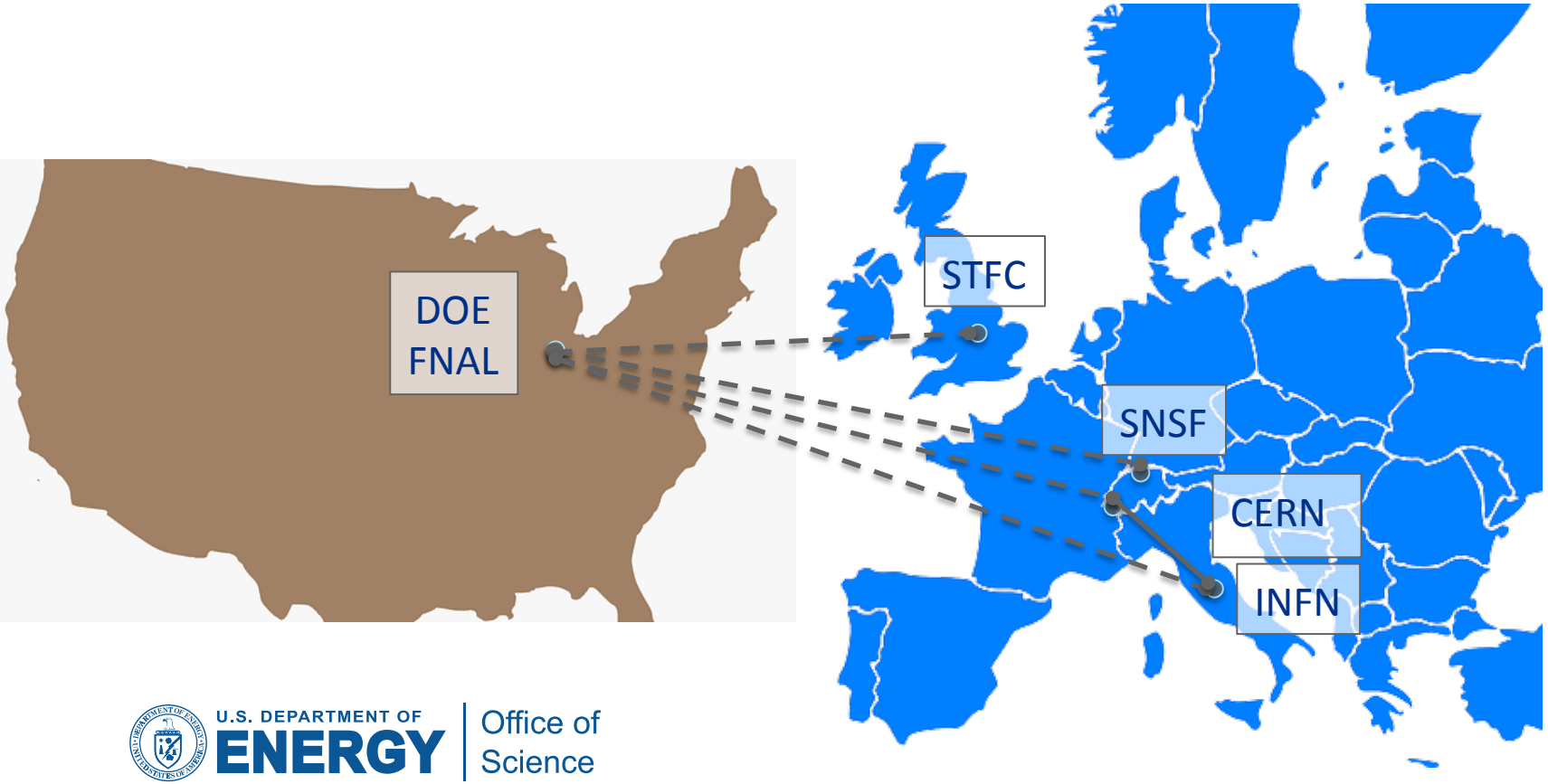
	INFN	CERN	DOE	NSF
Civil Construction			100%	
T600 Refurbishing including new PMTs, Cryostats (WA104)	50%	50%		
TPC Electronics	100%			
T600 Transport to FNAL	tbd	tbd		
Cryogenics		~50%	~50%	
Overburden			100%	
Cosmic Ray Tagger	25%*	25%*	tbd	?
DAQ	tbd	tbd	tbd	
Integration and Installation	tbd	tbd	tbd	

* - $1.2M CHF in WA104 agreement, estimate need at least 2 times this (core cost)
tbd – expect contribution but fraction not determined
? – possible grant proposal

SBND Funding Source Matrix

	UK STFC	SNSF	LANL LDRD	CERN	DOE	NSF
Civil Construction					100%	
TPC Design and Fabrication	55%					45%
TPC Electronics					85%	15%
PMT System			100%			
Calibration Laser		100%				
Cryogenics				~50%	~50%	
Cryostat				~90%	~10%	
Overburden					100%	
Cosmic Ray Tagger			100%			
DAQ					100%	
Integration and Installation					100%	

Main International Agreements



U.S. DEPARTMENT OF ENERGY | Office of Science

Agreement Status
- Signed
- In development

NSF

INFN

CERN

Science & Technology Facilities Council

FNSNF
Swiss National Science Foundation

ICARUS refurbishment at CERN (WA-104)

Addendum No. 02

to the
Memorandum of Understanding
for Collaboration in the Neutrino Program

WA104

Improving the ICARUS T600 Liquid Argon Time Projection Chamber (LAr TPC) in order to prepare for its operation at shallow neutrino depths.

Version_22-11-2014

The European Organization for Nuclear Research (CERN)

and

The INFN, on behalf of the WA104 Collaboration

endorse the Present Addendum to the Memorandum of Understanding with the indicated improvements of ICARUS T600 and with the related R&D on Liquid Argon Time Projection Chamber (LAr TPC).

for CERN 25/11/2014

The Director of Reasearch and Computing

Sergio Bertolucci

For INFN, on behalf of INFN participating Institutes

The President

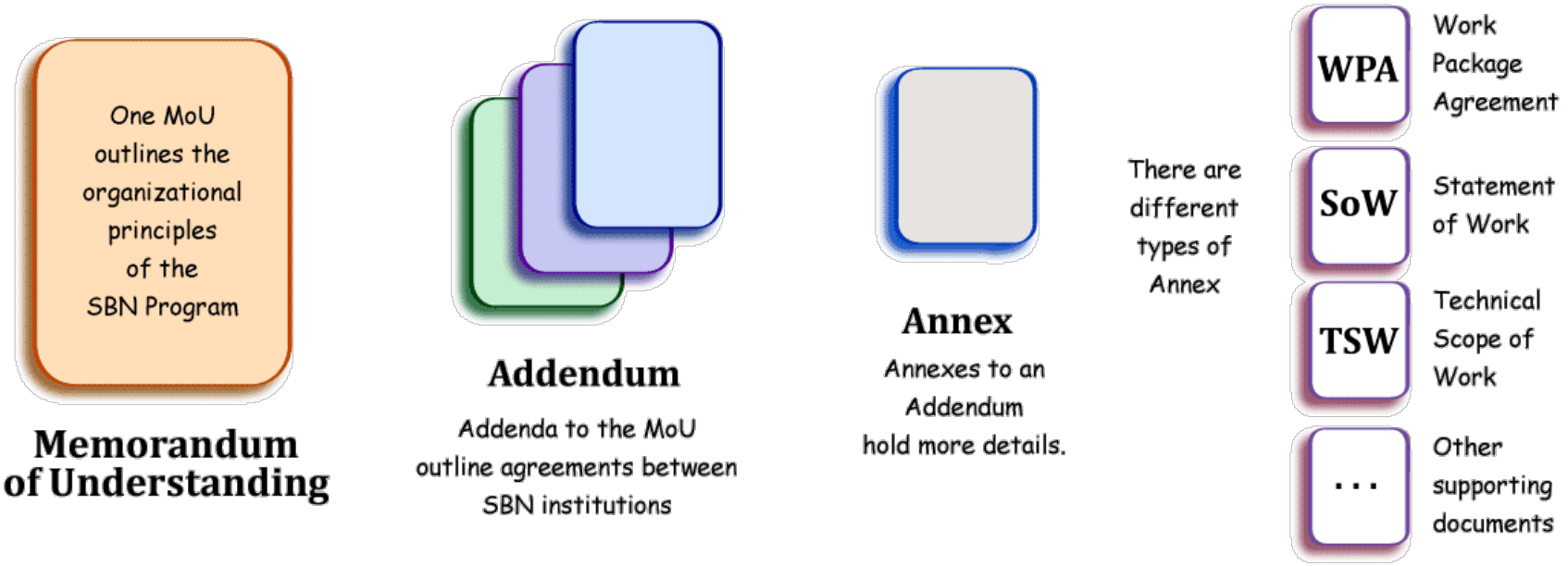
ISTITUTO NAZIONALE DI FISICA NUCLEARE
IL PRESIDENTE
Prof. Fernando Ferroni

Signature

Place and Date

ROMA, 28 NOV. 2014

SBN Collaboration MOU



- Draft MOU ready for review
- Drafts of first Addenda and Annexes ready for review
  - Bi-lateral covering design, construction and installation
  - Later: multilateral for operations and multilateral for physics
- Work Package Agreements drafted for cryogenics activities, SBND cryostat, several components of SBND
- Link to Sharepoint page:

DOE Cost Estimate

Program Schedule Development

- Integrated program schedule created using Microsoft Project
  - Maintained by SBN Program Office at Fermilab
- ICARUS-WA104 activities at milestone level (no resources)
- SBND activities detailed with resources – relatively mature
  - Bottoms up from L2 managers
  - Includes in-kind contributions
- Infrastructure
  - Civil construction activities at milestone level
  - Cryogenics includes sharing of responsibilities with CERN – New (Nov 2015)
  - Far detector integration as a Planning Package – New (Nov 2015)
- Not yet included (plan still in development):
  - Cosmic Ray Tagger for ICARUS
  - Common Online Integration
- Keep separate schedule:
  - BNB improvements – will make a separate schedule for AIPs

DOE Funding

- Building construction: General Plant Project (GPP) funds
- SBND design, construction and installation (incl cryogenics):
  - Detector R&D funds in a dedicated Budget & Reporting category
  - Managed by Neutrino Division
  - Budget FY15-18 ($3M, $3M, $3M, $1.5M)
  - Labeled: “R&D”
- ICARUS infrastructure design and installation support:
  (Also common activities such as management)
  - Detector operations funds fenced within Neutrino Division budget
  - Budget FY16-18 ($2.9M/year)
  - Labeled “OPS”
- BNB Improvements requested:
  - Accelerator Improvement Project (AIP) Funds FY17-19 $6.5M total

Note: All budgets and costs shown are fully burdened

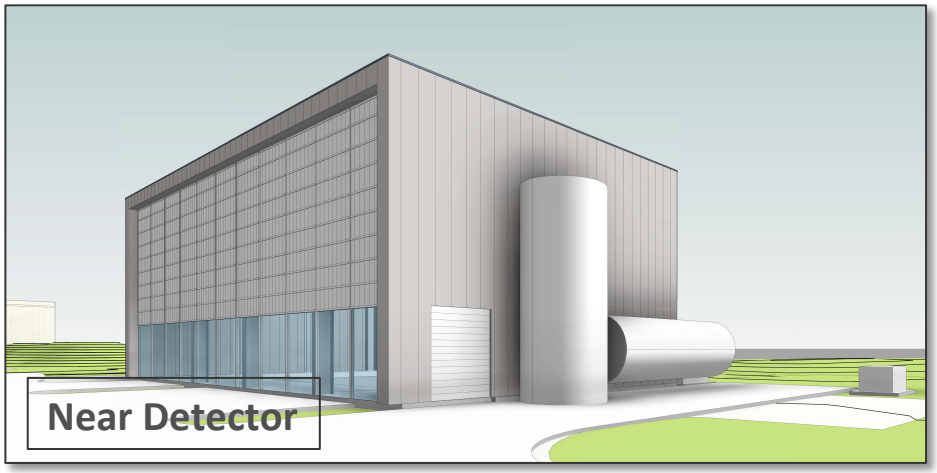
Conventional Facilities – GPP Funds

	FY14	FY15	FY16	Total
Site Preparation		1500	695	2195
Near Detector Building		1700	3645	5345
Far Detector Building	1000	5298	3502	9800
Total GPP Budget				17340

Budget covers :

- Engineering Design (EDIA)
- Construction Contract
- Management reserve

Managed by Fermilab Facilities Engineering Services Section (FESS)



DOE Base Cost Estimate

Revised tables this week

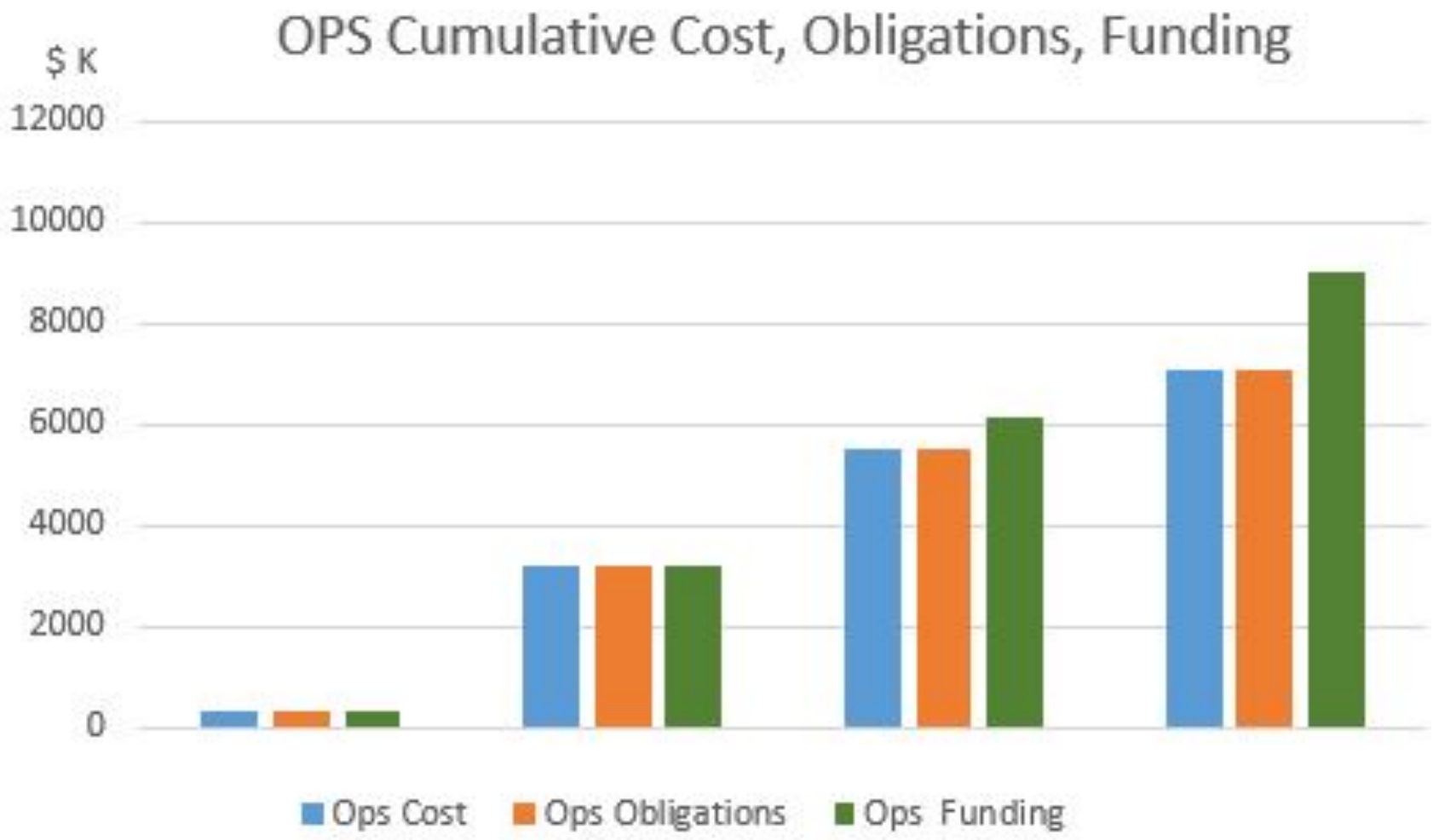
Each FY $K	FY 15	FY 16	FY 17	FY 18
R&D Cost / Budget	591	4,811	4,095	575
R&D Obligations	1,988	3,459	4,051	575
R&D Funding	3,000	3,000	3,000	1,500
Ops Cost / Budget	315	2,861	2,355	1,525
Ops Obligations	315	2,861	2,355	1,525
Ops Funding	315	2,900	2,900	2,900

Cumulative $K	FY 15	FY 16	FY 17	FY 18
R&D Cost	591	5,402	9,497	10,072
R&D Obligations	1988	5,447	9,498	10,073
R&D Funding	3000	6000	9000	10500
Ops Cost	315	3176	5531	7056
Ops Obligations	315	3176	5531	7056
Ops Funding	315	3215	6115	9015

Very little Management Reserve

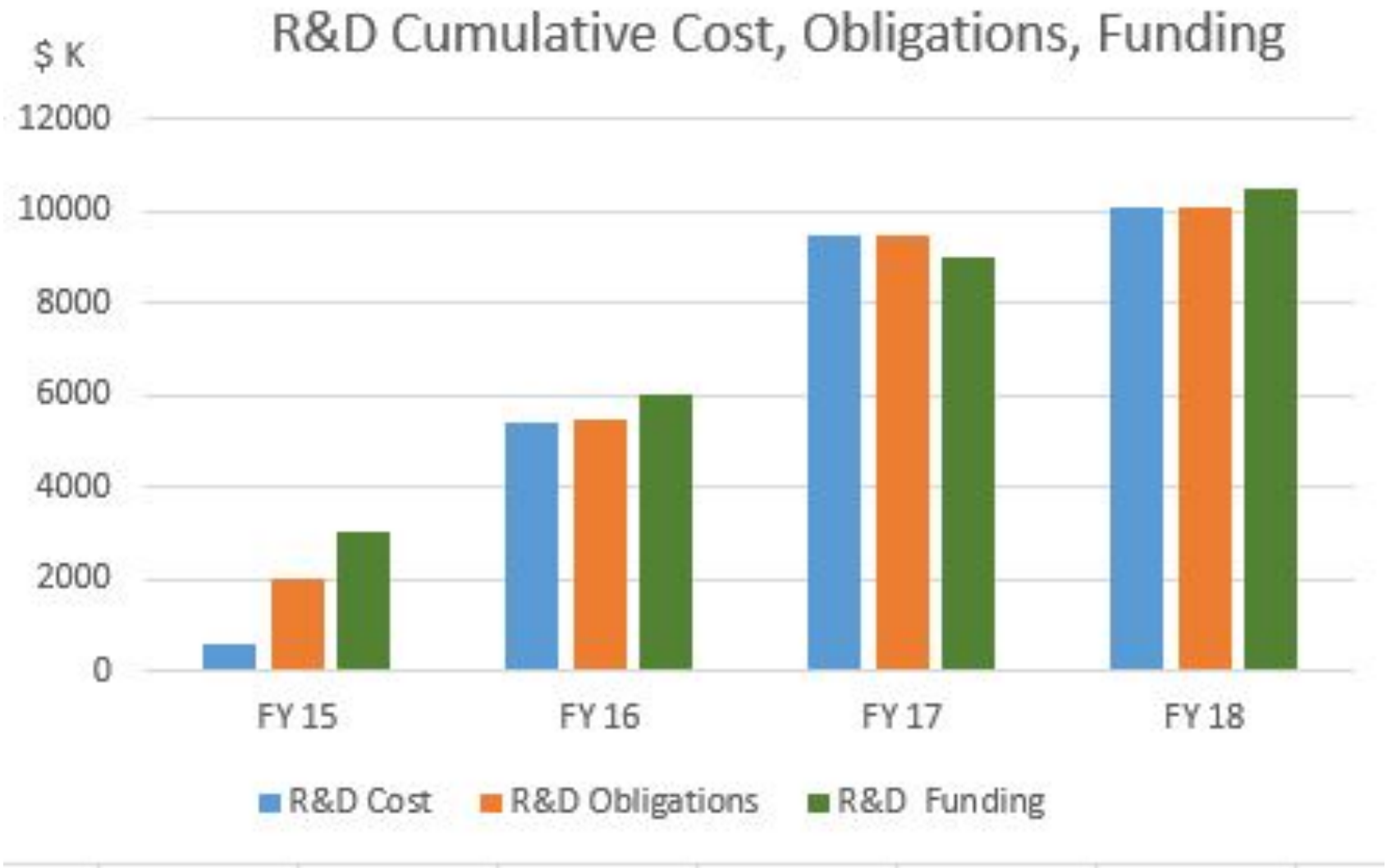
DOE Cost (OPS)

Revised chart this week



DOE Cost (R&D)

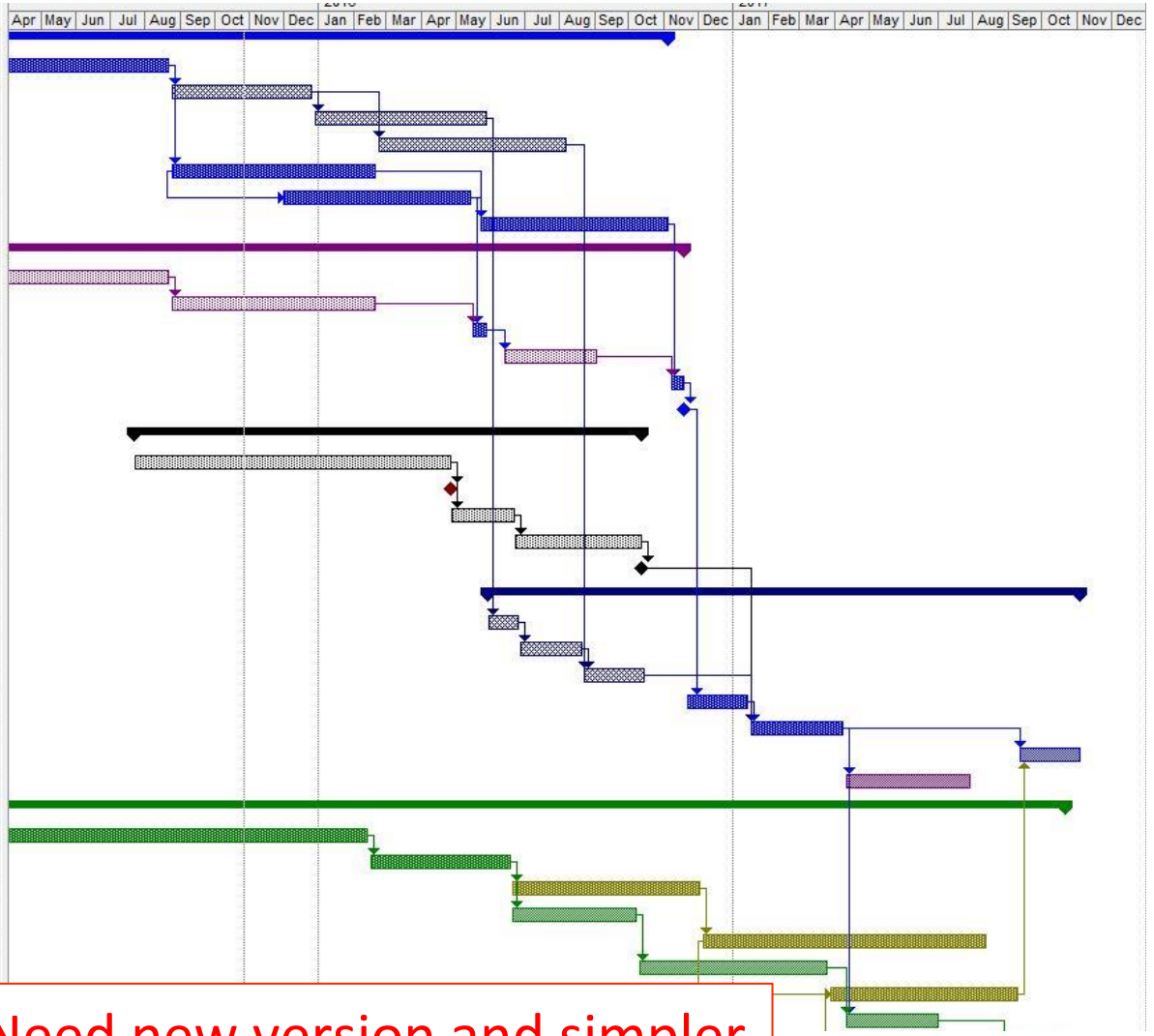
Revised chart this week



Schedule

Far Detector Schedule

	Task Name
1	FD Cryostats - Cold Vessels & Warm Container
2	New Cold Vessel Design
3	Warm container design
4	Warm vessel structure procurement & fabrication
5	Design and fabrication of GTT insulation for warm container
6	Cold vessels parts procurement
7	Cold Vessel 1 assembly
8	Cold Vessel 2 assembly
9	T600 Detector Maintenance & Upgrades
10	R&D for specification of upgraded parts (cabling, PMs, electronics)
11	Module 1 Refurbish - cathode flattening, recabling, new PMs
12	Module 1 pushed into Vessel 1, seal doors, vacuum test
13	Module 2 Refurbish - cathode flattening, recabling, new PMs
14	Module 2 pushed into Vessel 2, seal doors, vacuum test
15	T600 modules ready to ship
16	FD Building Construction
17	Foundation & Steel Framing construction
18	Partial BO - access to FD Pit (bridge crane, but no roof?)
19	Sheathing, Glazing, Roof
20	Electrical & Mechanical systems
21	Full BO - FD building completed
22	T600 Installation
23	Shipment of Warm Container structure CERN to Fermilab
24	Assembly of Warm Container inside FD Building
25	GTT installation of insulation
26	Shipment of T600 CERN to Fermilab
27	T600 Cold Vessels installed in Warm Container; install FT, Close top cap
28	Vacuum pump down
29	Readout Installation & pre-commissioning
30	FD Cryogenics
31	Engineering Requirements & design standards, P&ID development
32	Preparation of materials for vendor design procurement
33	Vendor design contract for proximity system
34	Vendor design contract for external system
35	Procurement & fabrication of proximity system
36	Procurement & fabrication of external system
37	Installation of proximity system (staged, as parts arrive)
38	Installation of external system (after detector is installed)



Need new version and simpler

Near Detector Schedule

Need simple schedule figure

Program Coordination

SBN Program Office

- Support realization of the SBN detectors and infrastructure at Fermilab
  - Work with program Technical Coordinators
- Ensure that detectors and infrastructure are compliant with Fermilab/DOE ES&H standards
- Assist in quality assurance planning
- Plan and oversee DOE funded components of the program
- Consists primarily of members of the Fermilab Neutrino Division

Program Office Members:

Program Coordinator – *Peter Wilson*

Deputy Coordinator – *Catherine James*

Program Mechanical Engineers

SBND integration – *Joseph Howell (PPD)*

ICARUS integration – *Andy Stefanik*

Program Electrical Coordinator – *Linda Bagby*

Logistics Coordinator – *Michael Dinnon*

ES&H Coordinator – *Angela Aparicio*

CERN-INFN-Fermilab Safety Coordination:

Fermilab POC – *Min Jeong Kim*

CERN POC – *Olga Beltramello (CERN-PH)*

Project Controls – *Richard Krull*

Financial Officer – *Molly Anderson*

Administrative Support – *Etta Johnson*

ES&H and QA

- Discuss responsibilities of all partners
- Follow local ES&H of institution where work is done
- Equipment must satisfy FESHM and pass ORC process

Needs more detail

Coordination of Common Solutions

- SBN cryogenics will share designs where applicable
- SBND working with ICARUS on PMT-based photon detection system
  - Take advantage of experience and facilities set up at CERN
- Cosmic Ray Task force being started to address common needs
- SBN – DUNE coordination:
  - SBND and DUNE actively planning common Cold Electronics design and testing plan
  - SBND pursuing light guide photon detection system as R&D toward DUNE
  - Started common DAQ hardware and software planning with DUNE (November workshop)

Summary

Status Summary

- Buildings progressing well: construction completion fall 2016
- ICARUS progressing well:
  - First T300 refurbishing will complete early 2016, second in mid-2016
  - Delivery of new PMTs started
  - Cryostat fabrication underway
  - New TPC electronics to fabrication contract early in 2016
- SBND designs nearing final stages
  - TPC in final design and preparing for fabrication
  - Redesigned cold ASICs nearing submission for fabrication
  - Cryostat nearly ready for contracts
  - Preliminary integration and installation plan completed

Status Summary (cont)

- Plan to address cosmic backgrounds still developing
  - Plan for overburden developed – New in Nov 2015
  - SBND Cosmic Ray Tagger (CRT) design ready for final design review
  - Design for ICARUS CRT in development
    - Need additional funding (e.g. not in DOE budget)
  - Initiating Joint SBN Cosmics Task Force (ICARUS, MicroBooNE and SBND) to finalize requirements and designs

Talk by Bob Wilson

- Plan for Online systems still developing
  - Capturing requirements for backend hardware and software
    - SNB-DUNE DAQ Workshop in November

Talk by Wes Ketchum

  - Examining choices for hardware and software platforms
- ICARUS Integration and Installation Plan
  - New Fermilab Team: Scientist, Engineer, Designer – Started Nov 2015

Talk by Andy Stefanik

Conclusions

- SBN Program is a staged campaign to install and operate multiple LArTPC detectors on the BNB to search for sterile neutrinos
- The program is managed as a combination of in-kind contributions and Fermilab managed DOE funded deliverables

Backup Slides

Three Collaborations ➔ One Program

The ICARUS-WA104 Collaboration

M. Antonello[16], B. Baibussinov[31], V. Bellini[5], P. Benetti[32], S. Bertolucci[6], H. Bilokon[15], F. Boffelli[32], M. Bonesini[17], J. Bremer[6], E. Calligarich[32], S. Centro[31], A.G. Cocco[19], A. Dermenev[20], A. Falcone[32], C. Farnese[31], A. Fava[31], A. Ferrari[6], D. Gibin[31], S. Gninenko[20], N. Golubev[20], A. Guglielmi[31], A. Ivashkin[20], M. Kirsanov[20], J. Kisiel[38], U. Kose[6], F. Mammoliti[5], G. Mannocchi[15], A. Menegolli[32], G. Meng[31], D. Mladenov[6], C. Montanari[32], M. Nessi[6], M. Nicoletto[31], F. Noto[6], P. Picchi[15], F. Pietropaolo[31], P.Płoński[42], R. Potenza[5], A. Rappoldi[32], G. L. Raselli[32], M. Rossella[32], C. Rubbia*[6,11,16], P. Sala[18], A. Scaramelli[18], J. Sobczyk[44], M. Spanu[32], D. Stefan[18], R. Suley[43], C.M. Sutera[5], M. Torti[32], F. Tortorici[5], F. Varanini[31], S. Ventura[31], C. Vignoli[16], T. Wachala[12], and A. Zani[32]

The LAr1-ND Collaboration

C. Adams[45], C. Andreopoulos[23], A. Ankowski[41], J. Asaadi[40], L. Bagby[10], B. Baller[10], N. Barros[33], M. Bass[30], S. Bertolucci[6], M. Bishai[3], A. Bitadze[25], J. Bremer[6], L. Bugel[26], L. Camilleri[9], F. Cavanna[a,10], H. Chen[3], C. Chi[9], E. Church[10], D. Cianci[7], G. Collin[26], J.M. Conrad[26], G. De Geronimo[3], R. Dharmapalan[1], Z. Djurcic[1], A. Ereditato[2], J. Esquivel[40], J. Evans[25], B.T. Fleming[45], W.M. Foreman[7], J. Freestone[25], T. Gamble[37], G. Garvey[24], V. Genty[9], D. Göldi[2], H. Greenlee[10], R. Guenette[30], A. Hackenburg[45], R. Hänni[2], J. Ho[7], J. Howell[10], C. James[10], C.M. Jen[41], B.J.P. Jones[26], L.M. Kalousis[41], G. Karagiorgi[25], W. Ketchum[24], J. Klein[33], J. Klinger[37], U. Kose[6], I. Kreslo[2], V.A. Kudryavtsev[37], D. Lissauer[3], P. Livesly[22], W.C. Louis[24], M. Lu□thi[2], C. Mariani[41], K. Mavrokoridis[23], N. McCauley[23], N. McConkey[37], I. Mercer[22], T. Miao[10], G.B. Mills[24], D. Mladenov[6], D. Montanari[10], J. Moon[26], Z. Moss[26], S. Mufson[14], M. Nessi[6], B. Norris[10], F. Noto[6], J. Nowak[22], S. Pal[37], O. Palamara*[b,10], J. Pater[25], Z. Pavlovic[10], J. Perkin[37], G. Pulliam[40], X. Qian[3], L. Qiuguang[24], V. Radeka[3], R. Rameika[10], P.N. Ratoff[22], M. Richardson[37], C. Rudolf von Rohr[2], D.W. Schmitz*[,7], M.H. Shaevitz[9], B. Sippach[9], M. Soderberg[40], S. Söldner-Rembold[25], J. Spitz[26], N. Spooner[37], T. Strauss[2], A.M. Szelc[25,45], C.E. Taylor[24], K. Terao[9], M. Thiesse[37], L. Thompson[37], M. Thomson[4], C. Thorn[3], M. Toups[26], C. Touramanis[23], R.G. Van De Water[24], M. Weber[2], D. Whittington[14], T. Wongjirad[26], B. Yu[3], G.P. Zeller[10], and J. Zennamo[7]

The MicroBooNE Collaboration

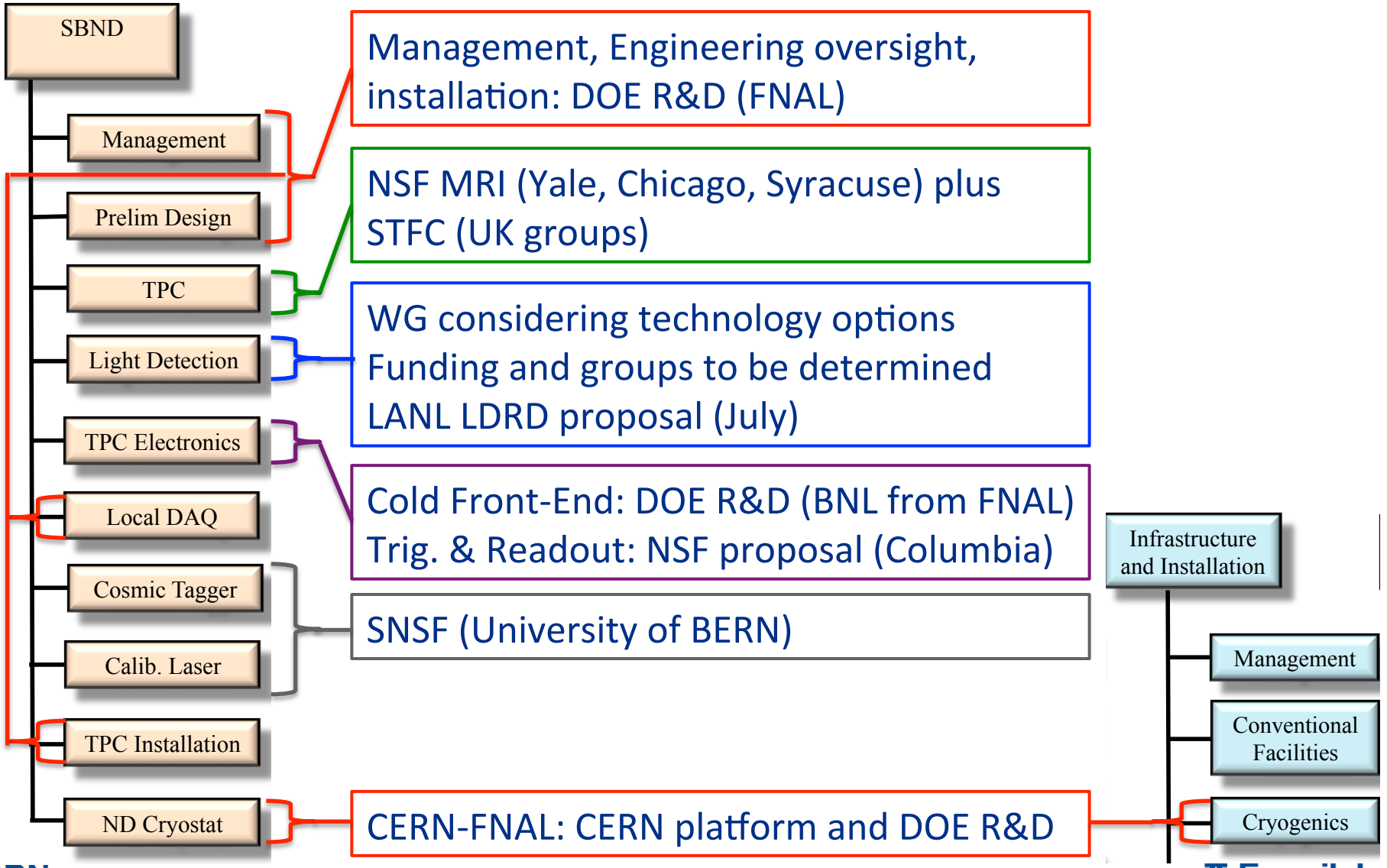
R. Acciarri[10], C. Adams[45], R. An[13], A. Ankowski[41], J. Asaadi[40], L. Bagby[10], B. Baller[10], G. Barr[30], M. Bass[30], M. Bishai[3], A. Blake[4], T. Bolton[21], C. Bromberg[27], L. Bugel[26], L. Camilleri[9], D. Caratelli[9], B. Carls[10], F. Cavanna[a,10], H. Chen[3], E. Church[10], G.H. Collin[26], J.M. Conrad[26], M. Convery[39], S. Dytman[34], B. Eberly[39], A. Ereditato[2], J. Esquivel[40], B.T. Fleming*[45], W.M. Foreman[7], V. Genty[9], D. Göldi[2], S. Gollapinni[21], M. Graham[39], E. Gramellini[45], H. Greenlee[10], R. Grosso[8], R. Guenette[30], A. Hackenburg[45], O. Hen[26], J. Hewes[25], J. Ho[7], G. Horton-Smith[21], C. James[10], C.M. Jen[41], R.A. Johnson[8], B.J.P. Jones[26], J. Joshi[3], H. Jostlein[10], D. Kaleko[9], L. Kalousis[41], G. Karagiorgi[25], W. Ketchum[24], B. Kirby[3], M. Kirby[10], T. Kobilarcik[10], I. Kreslo[2], Y. Li[3], B. Littlejohn[13], D. Lissauer[3], S. Lockwitz[10], W.C. Louis[24], M. Lu□thi[2], B. Lundberg[10], A. Marchionni[10], C. Mariani[41], J. Marshall[4], K. McDonald[35], V. Meddage[21], T. Miceli[28], G.B. Mills[24], J. Moon[26], M. Mooney[3], M.H. Moulai[26], R. Murrells[25], D. Naples[34], P. Nienaber[36], O. Palamara[b,10], V. Paolone[34], V. Papavassiliou[28], S. Pate[28], Z. Pavlovic[10], S. Pordes[10], G. Pulliam[40], X. Qian[3], J.L. Raaf[10], V. Radeka[3], R. Rameika[10], B. Rebel[10], L. Rochester[39], C. Rudolf von Rohr[2], B. Russell[45], D.W. Schmitz[7], A. Schukraft[10], W. Seligman[9], M. Shaevitz[9], M. Soderberg[40], J. Spitz[26], J. St. John[8], T. Strauss[2], A.M. Szelc[25,45], N. Tagg[29], K. Terao[9], M. Thomson[4], C. Thorn[3], M. Toups[26], Y. Tsai[39], T. Usher[39], R. Van de Water[24], M. Weber[2], S. Wolbers[10], T. Wongjirad[26], K. Woodruff[28], M. Xu[13], T. Yang[10], B. Yu[3], G.P. Zeller*[10], J. Zennamo[7], and C. Zhang[3]

Additional Fermilab Contributors

W. Badgett[10], K. Biery[10], S. Brice[10], S. Dixon[10], M. Geynisman[10], E. Snider[10], and P. Wilson[10]

Collaboration spokespeople
Fermilab SBN Program Coordinator

SBND Scope of Work and Funding



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        - Fifth level bullet [18pt Regular]

Comparison Slide [28pt Bold]

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Content and Caption Slide [28pt Bold]

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Picture and Caption Slide [28pt Bold]

Click to add caption text [16pt Bold]

Collaborations / Partnerships / Members 28pt Bold
Logos shown are examples